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RESEARCH and DEVELOPMENT news issue

Product Engineering

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RESEARCH AND DEVELOPMENT

ITALIAN DESIGNS

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ONE MAN ENGINEERING FIRM

...see page 30

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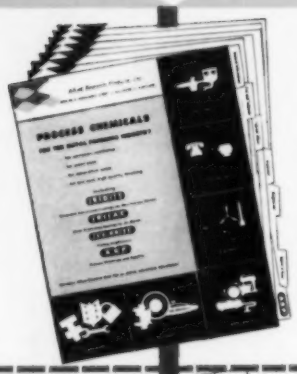

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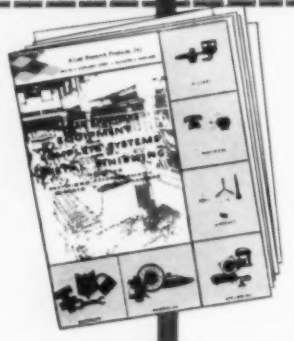

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To prevent trouble—know the cause. Here's how corrosion starts and how to stop it.

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Just peel off the backing sheet and hand pressure will do the bonding.

Rotary to linear motion: 20 converting mechanisms

Basic arrangements and adjustable crank-throws, plus special cases for dwells and intermittent motion.

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New high-speed metal removal makes spark discharge economical for soft metals too.

To predict cavitation in positive-displacement pumps

A simple graphical method anticipates trouble before it starts.

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN, RESEARCH AND DEVELOPMENT

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Product Engineering ..... SIDELIGHTS

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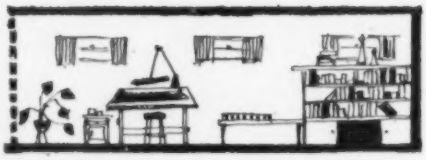
● **The office-in-a-cellar consultant** (p 30) may not have ideal working conditions, but he generally has as much space as he needs. We were looking over some Australian minimum standards of work



space for engineers and they might be pertinent here. There are eight divisions: Type 1 (absolute minimum; for typists, office machine operators, field officers) 3 x 2 ft table, 45 sq ft total. Type 2 (minimum clerical) 5 x 2 ft 10 in. table, 65 sq ft total. Type 3 (minimum supervisory; assistant and subsection engineers) 5 x 2 ft 10 in. desk, 80 sq ft total. Type 4 (minimum draftsman, assistant engineer) 6 x 3 ft drawing board, 5 x 3 ft table, 100 sq ft total. The remainder are private or semiprivate offices: Type 5 (district and sectional engineers) 100 sq ft. Type 6 (division engineer) 150 sq ft. Type 7 (branch head) 225 sq ft. Type 8 (department head) 300 sq ft. The last four are based on space needed for 2-, 4-, 8- and 12-man conferences. This is all very scientific, but we tend toward a modification of Parkinson's Law: Space needed contracts to fit space available.

● **The language barrier** is the big problem when American engineers want to use foreign technical information (p 38). Most Europeans speak English; relatively few American engineers speak even one foreign language and practically none speak Russian. The B F Goodrich people went to the heart of the matter and last month instituted a 7-month technical Russian course for their research center scientists. With Russian translations costing as much as $20 per page, this is an economical and potentially profitable program. Note that the USSR is not a member of the international copyright or patent conventions . . .

● **Moscow News** (while we're on the subject) recently reported that "Engineer Boris Blinkov has designed a 1.5-hp internal combustion engine which runs on diesel fuel. It weighs 300 grams (⅔ lb) and is so small that three such engines can be easily carried in a coat pocket." We'll take three—for the outboard.

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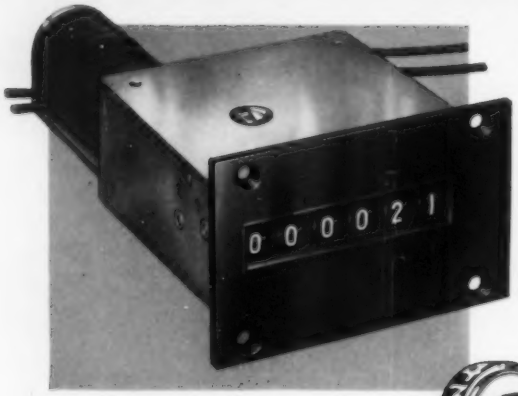

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DEVELOPMENTS TO WATCH...

A

Isotope power is making progress . . .

. . . not just in batteries and "packaged" thermoelectric devices (*PE*—Feb 9, p 14) but also for operating signal buoys, supplying rocket and missile auxiliary equipment, and preheating fuel oil for ground vehicles. None of the latter group is "commercial" yet; but every one is under active development and several companies are involved.

For instance, Martin Co's Nuclear Div, which built the thermoelectric battery displayed at the White House during Mikoyan's visit, is now planning feasibility studies of radioisotopes as means for heating cathodes of radio tubes, and for keeping dry cells operating under Arctic conditions.

Greatest need now, says Martin, is for processing plants that will make the radioactive materials available on a larger scale and at lower cost.

Gas bearings running at 2000 F . . .

. . . and at speeds to 50,000 rpm have been tested successfully by Sundstrand Turbo, Pacoima, Calif. The gas used is hydrazine or ethylene oxide. It serves as the drive gas for an auxiliary turbine, and is bled off for the bearings. The same company also reports it now has electrically operated valves capable of handling fluids at over 1500 F in surrounding temperatures over 1000 F.

High-modulus glass-reinforced plastics . . .

. . . that rival steel and aluminum in their rigidity and elasticity are being developed under Wright Air Development Center sponsorship.

One approach uses glass flakes (*PE*—Nov 4 '57, p 5) as reinforcement, has already produced materials with modulus of elasticity/specific gravity ratios "consistently exceeding 3,000,000 psi" (the approximate level of the common metals).

Another approach uses a new type of glass fiber which itself has an elasticity nearly twice that of the conventional material.

While both types of material are still in the developmental stage, and many manufacturing problems remain to be worked out, WADC foresees a multiplicity of applications "wherever rigidity and light weight are vitally important."

Design holds the key to nuclear aircraft . . .

. . . says Maj. Gen. D. J. Kiern, Asst. Deputy Chief of Staff, Nuclear Systems Development, USAF.

The lack of materials capable of withstanding high temperatures and nuclear radiation has been widely cited as a stumbling block, if not a total barrier, to nuclear aircraft development. Gen. Kiern says—not so. One way to increase propulsion efficiency, he admits, is through higher propulsive air temperatures. But, he notes, "improvements in thrust can also be achieved through adroit engineering design which takes maximum advantage of the available materials technology." Significant increases in system efficiencies and performance have already been accomplished, without any breakthrough in materials, by expert design and good engineering; and, he says, much more can be done this way.

High-precision cast plastic mirrors . . .

. . . can now be made at ½ to ¼ the cost of ground mirrors, says Singer Mfg Co. Its HRB Div has developed and its Military Products Div is ready to produce shock-resistant (to 22,000 g), lightweight mirrors, even in unusual shapes. These, it says, are perfect replicas of the ground original which is used as a pattern. One 6-in. paraboloidal mirror, for instance, "concentrates more than 90% of the incident collimated light within a disk $\frac{1}{16}$ mm in dia."

Furthermore, says Singer, metal inserts, fixtures, or electrical components can be cast into the plastic (epoxy resins are used); and the reflective coatings "show excellent adhesion."

Top operating temperature depends upon the type of epoxy; but mirrors so far made are not recommended for temperatures above 125 to 150 F. Largest "Repli-kote" mirror so far made is 10 in. dia; but it may be possible to produce bigger ones. —ARG

DEVELOPMENTS TO WATCH...

World-wide

Metal-coated metal and ceramic powders . . .

. . . that promise improved properties for powdered-metal and metal-ceramic parts are soon to be made available on a semicommercial basis from Sherritt Gordon Mines Ltd, Fort Saskatchewan, Alberta, Canada.

These are metal and nonmetal powders coated with nickel, cobalt, copper and other metals by gaseous hydrogen precipitation from an ammoniacal solution at temperatures of 300 to 400 F and pressures of 200 to 500 psi. Particles ranging all the way from less than one micron to several hundred microns can be coated this way, and lend themselves to roll-compacting (direct production of metal strip from powder) as well as to the standard pressing and sintering techniques.

A special advantage of the new coated powders, says V. N. Mackiw, S-G's R & D director: They make it possible to introduce small percentages of very fine, hard, nonmetal phases uniformly throughout the matrix metal, thus providing high-quality dispersion-hardened alloys. One example is a nickel-3% chrome oxide material which S-G has successfully roll-compacted, using techniques previously developed for and applied to production of pure nickel strip

New type of ac motor . . .

. . . with dc excitation to the stator and 2-phase ac on the armature is being developed at PSG College of Technology, Coimbatore, India, Prof. P. K. Charlu told the AIEE. He says it combines the best features of both types of motor—smoothly adjustable speed and power factor control. In basic design, he says, the machine is similar to a synchronous flux generator (MIT's Generalized Rotating Electromechanical Power Modulator was used in developing the new concept); and output frequency, phase angle, and torque angle are all independent of armature speed. In the PSG machine, however, dc is used for field excitation of the stator.

Thus far, only a small experimental machine has been built; but the professor sees no bar to larger sizes, and says single-phase systems are also possible.

He points out that speed and power factor are easily adjusted by varying the dc field excitation or the voltage applied to the armature, or by advancing or retarding the synchronously revolving brushes. The brushes themselves may be driven by a separate motor and gear, or may be locked to the rotor or stator.

Molded nylon chain for lightweight drives . . .

. . . has been developed by George Goodman Ltd, Robin Hood Lane, Birmingham 28, Eng, in cooperation with Imperial Chemical Industries.

Low inertia; resistance to abrasion, wear, and chemical attack; electrical insulating properties; and ability to operate without lubrication are said to be among its advantages. Applications are expected to range from food machinery to electrical indicating and recording devices.

First type to be made available commercially has an 8-mm pitch and is designed to sustain a driving load of 3 lb (static load: 5 lb). The chain itself has a tensile strength of 25 lb; impact strength, 1.0 to 1.5 ft-lb (¼-in. notch); modulus, 4.3×10^5. Maximum recommended working temperature is 275 F.

—ARG

Plastic drive chain features self-clinching pivot pins, can be made in almost any length, shows good dimensional stability, runs smoothly and quietly.

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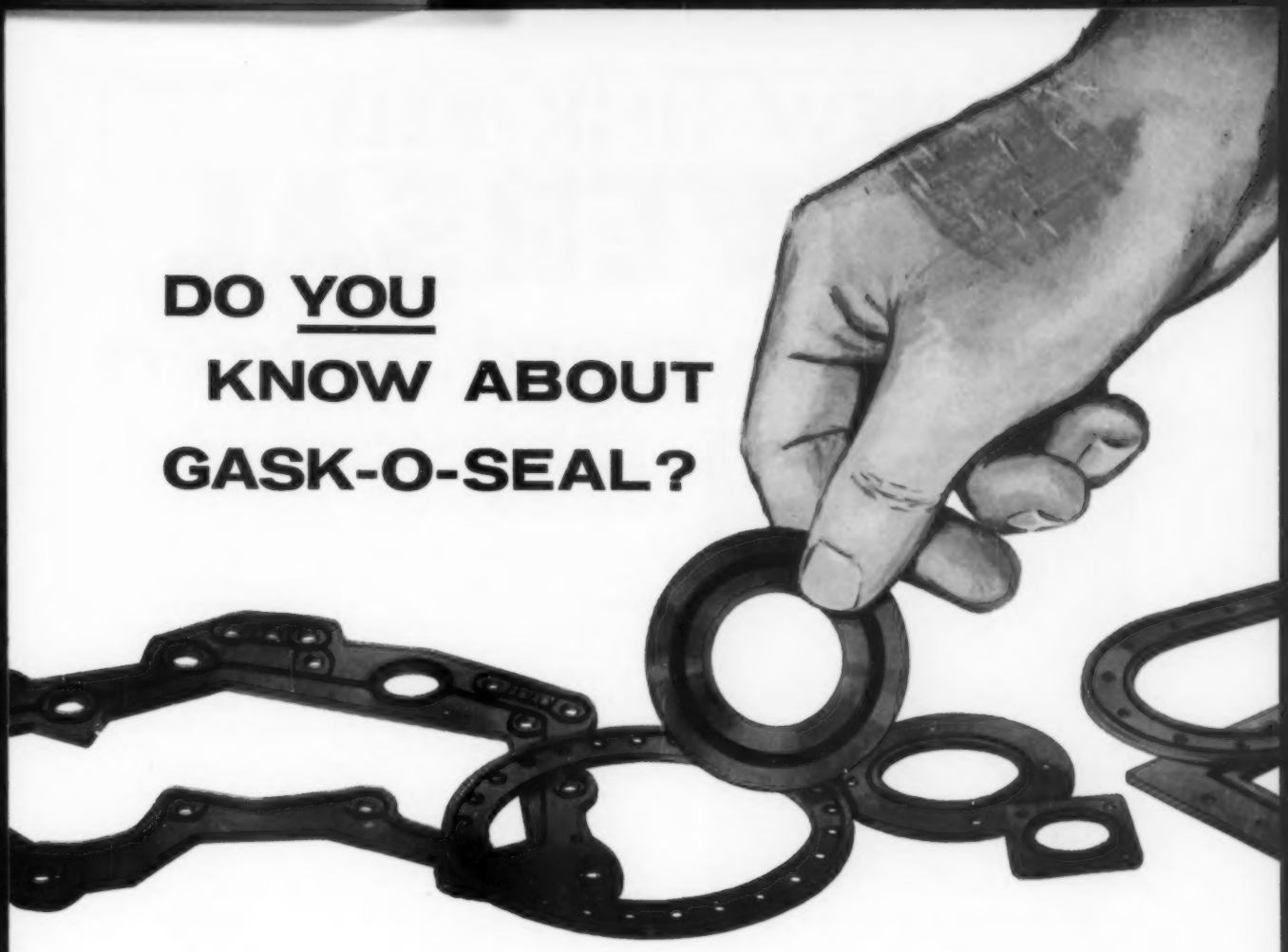

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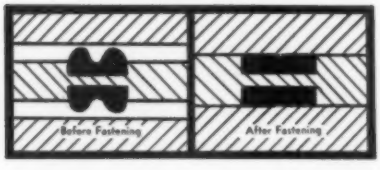

The above diagram is "typical" only. Gask-O-Seals are also made with one-side seals.

If you do not know about Gask-O-Seals look at these facts:

- ✔ Gask-O-Seals will seal practically any processable fluid . . .
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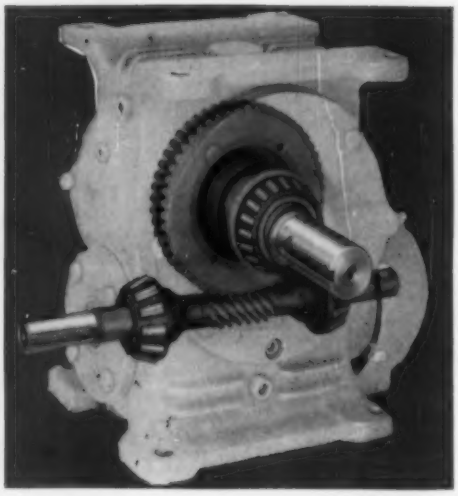

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MOUNTING B — worm shaft below gear.

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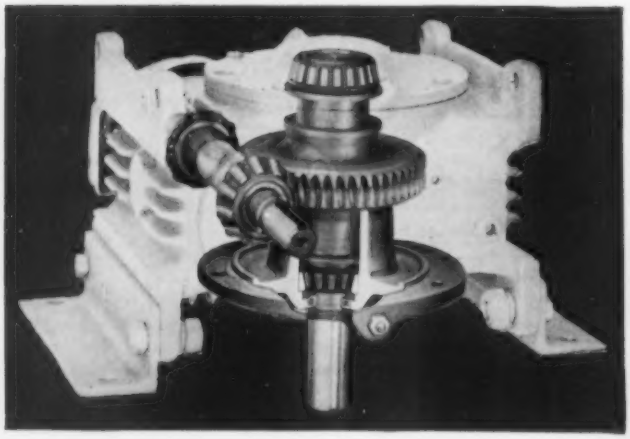
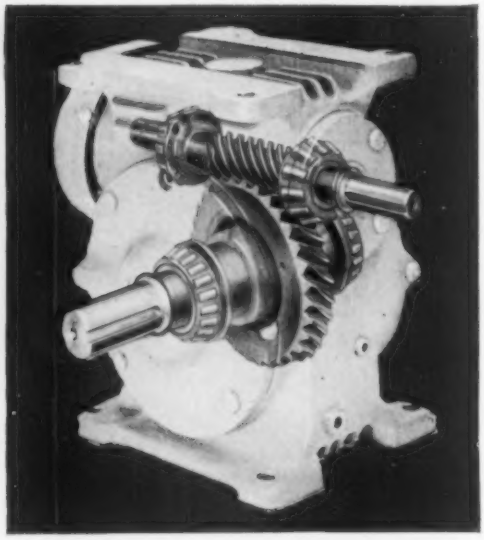


MOUNTING V — Output shaft vertical — upward or downward.



MOUNTING T — worm shaft on top of gear.

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DEVELOPMENTS TO WATCH...

Washington

More defense money for materials . . .

research may be pumped into circulation. Officials in charge of the materials branch in the Pentagon's Office of Research and Engineering have asked for an additional $40-million to beef up research and development in this field. The office already spends around $40 million annually on materials research.

Idea behind the move is to provide weapons designers with a broader range of materials to use in new design. Right now, this lack is regarded as a serious handicap in weapons designs.

If the Pentagon approves the addition of more funds, they will go for: more basic research in the solubility limits of oxygen, hydrogen, and nitrogen in beryllium; the composition of high temperature gases; free radical reactions at elevated temperatures; heat transfer; and more.

Part of the money will go for the further development of light metals such as beryllium, lithium, boron and magnesium. Research on ceramics, cermets, and graphite will also get a boost.

Spending will be split between universities, industry and Government laboratories.

A new company problem . . .

that of copyright infringement in reproducing technical information, is just around the corner.

Many companies now reproduce technical information from a variety of sources—magazines, scientific papers, etc—with little concern about copyrights.

New guide rules on this point are in the making however. Prime stimulus is not disgruntled copyright holders. It is more a matter of confusion that needs clearing up.

The matter is reaching a head with the growth of machine collection and dissemination of information—microfilming for example. These companies want some official rules spelled out as to just what they must do to conform with the present copyright law. This is extremely vague in the key area of "fair use."

The issue will be discussed this April at the meeting of the National Science Foundation's new scientific information council. There is a good chance, too, that the Library of Congress, charged with handling copyright registration, will ask Congress to alter the law this session.

A satellite detection "fence" . . .

is being built across the southern United States. First stations are already in experimental use. The complete net won't be in full operation for another year or so, however.

Purpose of the "fence" will be to detect Soviet satellites that may be sent over the US to ferret out military secrets.

In all, there will be nine radio listening posts. Three will be minitrack stations similar to those used to track our own satellites, and six will be Doploc—on the doppler principle—stations.

The Army and Navy will operate the nine detection stations with information fed into the Air Force's Cambridge Research Center for evaluation.

The Pentagon terms the stations in an R & D status now. Total cost is estimated at $10-million.

Patent practices and policies . . .

of government agencies are being hauled up for inspection. A Senate judiciary subcommittee has started digging into the patent practices of some 19 Government agencies.

First reports are now available. They show that the National Science Foundation allows its inventors to obtain a patent, with government getting royalty-free, non-exclusive rights to the invention.

The Tennessee Valley Authority (TVA) however, takes title to the patent rights but makes them available to private industry on a royalty-free basis.

This year, the subcommittee will issue reports on the patent practices of these other agencies: Agriculture, Commerce, Interior, Army, Navy, Air Force, National Aeronautical and Space Administration, Justice, Post Office, Treasury, Health, Education and Welfare, Atomic Energy Commission, Federal Communications Commission, Veterans Administration, General Services Administration, Government Printing Office, and the Government Patents Board.

Out of it all, the committee hopes to get some uniformity in the Government's handling of patents.

Change the weather? 'Tain't worth it

Any major attempt to change the weather would be fantastically expensive, says H. Wexler, director of meteorological research at the US Weather Bureau; and it might do more harm than good.

Two streams of radiant energy, Wexler points out, dominate the earth's climate:

One, directed downward, consists of residual solar radiation absorbed by the earth's surface and atmosphere.

The other stream, directed upward, is infrared radiation emitted to space by the earth and its atmosphere.

Changing the weather, then, would be a matter of controlling one stream or the other. For instance, Wexler notes, "Various proposals have been made for changing the albedo (reflectivity) of large portions of the earth's surface to influence the percentage of solar radiation absorbed." But any such blackening process (deposition of carbon dust on deserts, for instance) would cost billions of dollars, and would not be too effective.

Stopping heat emission on the other hand, would be a matter of creating artificial clouds or ice fogs (by nuclear explosion, perhaps). This might be effective in warming one area; but would inevitably result in cooling and increasing the precipitation in others. It would be a matter of robbing Peter to pay Paul.

Although Wexler does not mention it, this is just what has already caused complaints about rainmaking experiments. There have been accusations that ice-seeding simply caused rain destined for one place to fall on another, thus "robbing" the original destination.

Looks as though current methods of heating and air conditioning will be around for a while.

Space: where is it?

The answer to that question apparently depends on who's supplying it. At a recent meeting, the Air Force Deputy Chief of Staff for Development asked three of his men—an engineer, a biologist, a physical scientist—to define it.

Said the engineer: "I think of space as the medium primarily characterized by the significant reduction or total absence of the earth's atmospheric forces . . . forces of gravitational attraction dominate space flight. In my mind, space starts at that minimum altitude at which at least one complete circular orbit of the earth can be made by an unpowered space vehicle."

Said the biologist: "Space extends outward from the level at which the atmosphere becomes incapable of sustaining all physiological functions essential to human life. The region of space equivalence extends from 12 mi, where the atmosphere ceases to support respiration, to 120 mi where it ceases to contribute to human existence in any material way."

Said the scientist: "Space is that which is characterized by extension in all directions, boundlessness and indefinite visibility . . . But, what people seem to mean now is that point where air-breathing engines are not applicable, aerodynamic surfaces are ineffective for lift and control—and the earth's gravitational field is ineffective on a body."

Speaking for himself, as a military man, the Deputy C. of S. said: "Space means within the atmosphere or terrestrial, cislunar, translunar interplanetary, interstellar and intergalactic areas." This, he notes, is the area which can be considered as an extended field for military operation.

—ARG

Power for tomorrow

To help train atomic-engineers of the future, the AEC has set up a new assistance program for direct financial assistance to colleges and universities; and equipment-suppliers are readying "student laboratories" like the Nuclear-Chicago setup pictured here.

The AEC's list of equipment for which procurement assistance will be available includes Geiger-Mueller, scintillation, and gas-flow counters; also ionization chambers, scalers, pulse analyzers, radiation sources, and radioactivity standards. Information on the assistance program may be obtained from AEC's Office of Isotopes Development, Washington 25, D. C.

Typical student laboratory might include (left to right) lead-shielded G-M counter and sample-holder; timer-scaler; set of radioactive sources and standards; and (not shown) radioactivity absorbers.

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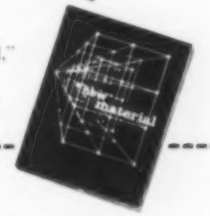

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High-temperature wire

Progress in developing wire insulation for service at temperatures to 1500 F has not been rapid, but has reached the point at which, says Georgia Tech's Engineering Experiment Station, it now requires "only a minor effort" to provide a wire system suitable for service to 1500 F in "one-shot" applications at least.

First step in this development (previously reported) was a coating that combined an organic resin with a glass filler, on the theory that at high temperature the resin would burn out and the glass would fuse, forming a continuous coating. Trouble was that glass, in a liquid state, acts as a conductor, not an insulator.

So next step was to provide an undercoating that would remain nonconductive. Aluminum oxide, obtained by anodizing an aluminum coating, seemed like the best bet, if some way could be found to prevent the aluminum from diffusing into the copper and to protect the oxide from moisture.

Most promising solution to the diffusion problem now seems to be one that starts with an electrodeposited barrier layer (silver) on the copper wire. The wire can then be covered with an extruded aluminum tube, and the two bonded by swaging and drawing. Georgia Tech notes, though, that any such system will not be serviceable above 1100 F, the melting point of aluminum.

To provide a moisture barrier, Tech is now testing colloidal silica coatings, deposited by electrophoretic means, as replacements for the resin-glass mixtures. Preliminary tests indicate their superiority to the earlier type, and even it will reach the goal noted above.

Stronger glass on the way?

Glass 100 times as strong as that now available commercially can be produced in the laboratory, J W Hackett, Owens-Illinois Research Director points out. The trouble so far is that such strength doesn't last.

Newly blown glass has a surface strength approaching 250,000 psi; while the recognized design strength of the material is only 2500 psi.

What happens?

Apparently, there are immediate atmospheric effects on the surface of glass. These weaken it and, as glass does not have the ability to distribute stress that metal does, over-all result is the low-strength material we know.

There's hope, though, that a way will be found, either to distribute the stress or to preserve the initial strength. A good many laboratories like O-I's are working on it; and such theoretical studies as those now underway at National Bureau of Standards (*PE*—Nov. 17 '58, p 10) may provide the needed clue.

Harder glasses may be coming up too. A Dutch company claims an acid bath-silicone treatment that makes glass "as hard as steel." It is ready to license other companies to use it.

Our own glossary

IV—Definitions for Danger

Hazardous, *toxic* and *flammable*, as they apply to manufactured products and materials, get new, specific definitions in a model labeling law proposed by American Petroleum Institute, National Paint Varnish & Lacquer Assn, Chemicals Specialties Manufacturers Assn, and Manufacturing Chemists' Assn.

A **hazardous substance,** says the joint proposal, "means any substance or mixture of substances which is toxic, corrosive, flammable, or which generates pressure through decomposition, heat, or other means, if such substance or mixture of substances may cause substantial personal injury or illness during any customary or reasonably anticipated handling or use." The term also applies to materials which are irritants or strong sensitizers.

Toxic is applied to "any substance which has the inherent capacity to produce bodily injury to man through ingestion, inhalation, or absorption through any surface, with *highly toxic* being reserved for those substances which produce death within 14 days in laboratory animals tested under specified conditions.

The term **flammable** covers any substance which, in the Tagliabue Open Cup test, has a flash point of 20 to 80 F; with *highly flammable* applying to those whose flash points are below 20 F.

(Note: For other new definitions as they apply to materials, see *PE*—Apr 21 '58, p 17; May 5 '58, p 16; Jan 26 '59, p 13.)

briefs . . .

Zinc price rise based on demand, not government support, is foreseen by economists at Hayden, Stone & Co. Noting a "record high demand from galvanizers and an increased call for Special High Grade from diecasters," they believe it likely that the price of zinc may, by itself, reach the 13½¢ level it would have attained under the Seaton support plan. They also point out that zinc stocks are now at a low point, and that alloying uses as well as direct applications are on the increase. Not all the experts are this bullish by any means; but they do agree that zinc is looking up.

Manganese antiknock compounds are making rapid progress. They're not yet ready for commercial introduction. But they are being tested by all major auto companies; and, in at least one case, have permitted test engines to run at far higher compression ratios than otherwise practical.

Ethyl Corp is now offering at least one such manganese compound on a developmental basis. It's a liquid that freezes at 34 F and boils at 450 F; has been given the experimental number AK-33X. (For more information on the interesting new compounds, see *PE*—May 26 '58, p 30 and Nov 10 '58, p 36). —ARG

MORE ABOUT THE GARLOCK **2,000**

(above) Fresh driver takes over underway during 50,000 mile test conducted by Kiekhaefer Corporation, makers of Mercury Outboard Motors. *(right)* KLOZURE Model 71A7 used on the Mercury has exclusive non-abrasive, free running sealing element resistant to oil, water, grease, heat and cold.

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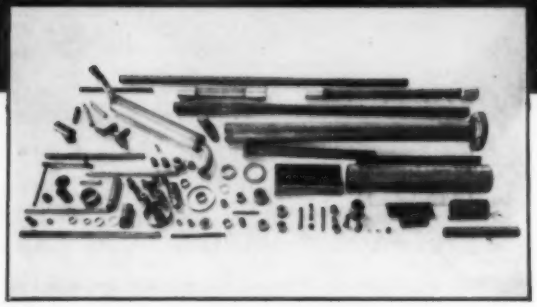


Seven-million miles of street and industrial sweeping in 700 cities have proved rugged dependability of Wayne Manufacturing Company's equipment. Here is the final assembly line in its plant. Large horizontal tube on sweeper is jack shaft housing for gutter broom drive. Wayne makes 300 parts from Pittsburgh Steel's Seamless cold-drawn tubing (see inset at right). That's how . . .

Pittsburgh Steel Seamless Tubes Help Wayne Make Clean Sweep

Nobody knows how many brooms it would take to keep the world clean. But out in Pomona, California, Wayne Manufacturing Company is ready to tackle the job with a complete line of power sweepers.

Founded only ten years ago, the Wayne Company has grown rapidly until today it produces more street and industrial power sweepers than all others in the field combined. Wayne is the only power sweeper produced by assembly-line operation.

Largest Wayne sweepers handle up to four cubic yards of debris at a time. Their assembly requires more than 1,000 complicated and accurately manufactured steel parts.

• **300 Key Parts**—Of these, more than 300 key items are fabricated from Pittsburgh Steel Company's Seamless Tubing in both carbon and alloy grades in sizes ranging from one-quarter inch to six inches in diameter. It is furnished cut to length and ready for fabrication by Baker Steel & Tube Company of Los Angeles, a Pittsburgh Steel distributor.

This service helps speed Wayne production, keeps inventories down and is typical of service rendered by all Pittsburgh distributors.

"Requirements for the parts produced from Pittsburgh tubing are exacting," says Wayne production vice-president, Roy E. Nelson. "Our sweepers are doing big jobs, many of them operating on a 24-hour schedule, and we

CIRCLE 57 READER SERVICE CARD

must have a tough, dependable product in the critical spots to take this constant heavy beating."

That is why Wayne uses Pittsburgh Seamless Tubing in critical components such as rugged axle assemblies, torque housings, drive shafts, hydraulic actuating cylinders—even small fittings.

Over the years, Wayne production men have found Pittsburgh tubing has the surface finish, close size tolerance and concentricity which minimize the amount of machining that must be done. Its uniformly high physical properties and internal soundness provide the stamina necessary for long, trouble-free service.

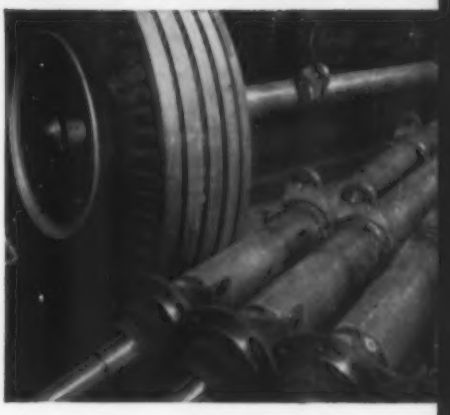
• **Ease of Fabrication**—The machinability and weldability of Pittsburgh tubing make for ease of fabrication, keep scrap losses down, and assure uniform parts—all important factors in keeping production lines moving smoothly.

As an aid to industrial good housekeeping, Wayne produces smaller power sweepers for use inside and outside plants. Its newest line is the Autoette series which includes the glamorous "Golfmobile" and the family "Cruise About." Three industrial models provide efficient transport of personnel and materials in sprawling plants.

These industrial sweepers and Autoettes also depend upon Pittsburgh Steel tubing for parts in key assemblies.

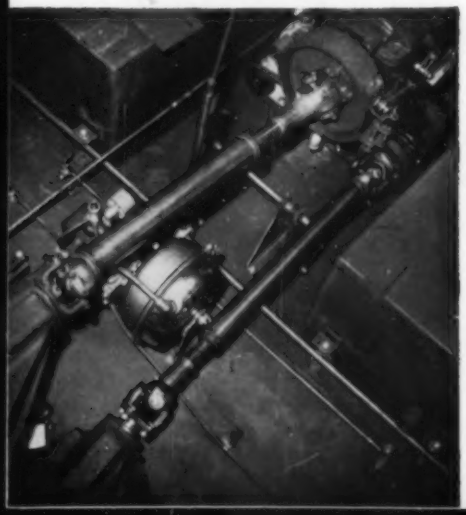
Manufacturers find the uniformly high quality of Pittsburgh cold-drawn steel seamless tubing and excellent service from Pittsburgh distributors are big assets in improving products and operating efficiency. To enjoy these benefits get in touch with the representative nearest you.

Machinability and weldability of Pittsburgh tubes are vital in making this shaft which goes into differential assembly. Short tube is welded over longer, smaller diameter tube, then machined to tolerance of .001 inch to assure perfect fit in housing.



Rugged front axle assembly of Wayne sweeper made from Pittsburgh tubes carries most of weight of machine and up to four cubic yards of debris. It must withstand road shocks and constant heavy-duty operation.

Pittsburgh tubes withstand torque and fatigue in main and auxiliary drives on Wayne sweepers.



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HORIZONS

February 23, 1959

The tale of the hen

The tale has been told of the statistics-minded chicken. She noticed that each time the farmer came to her cage, food was left for her. But she was a cautious hen, so she kept count. For 999 times, the farmer left food. So, on the 1000th visit, her statistical mind was satisfied, and she came eagerly to the food pan when he came to the cage. Whereupon he caught her—and wrung her neck.

There are hundreds of us who emulate the hen—even if we're cautious. Thus it happened 999 times; thus it will always be. And that's when our necks are wrung.

I remember once when the cast-steel master cylinder of our 2000-ton hydraulic press failed. A company promoting a new type of laminated-steel cylinder got the replacement order. Three years later, the new 36-in.-dia cylinder failed, and we were deluged with lab doctors who tried to determine the cause. Finally, our works manager, a 5th-grade graduate with a bump of curiosity, came up with a question: "I've been hearing of something called metal fatigue. How many cycles did you test this steel for?"

One doctor pooh-poohed the question with: "Oh, we tested this steel for a million cycles—it couldn't be that."

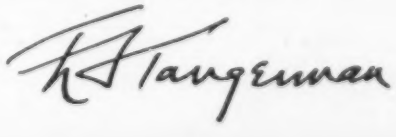
"Couldn't it?" said the works manager softly: "Multiply 90 cycles per hour by 18 hours a day for three years."

The total turned out to be a million and a quarter. We went back to cast steel, and the lab men to developing a new, stronger steel. Until then, they'd thought a million cycles was more strokes than anybody could ever require—and of course that steel that could stand a million cycles could stand anything.

Here is the case of the hen all over again. Statistics didn't lie; they just weren't enough alone. Pure observation and analysis would have helped.

Too many of us accept statistics as fact, when they are merely the record to date. Because something has never happened, there is no assurance that it will not, unless it cannot. Because a material didn't work 20 years ago, or a process was uneconomic last year, no one can assume that the conditions of the former test still exist.

Dozens of sages have provided us with sayings about this danger. An old one is: "The man who says it can't be done is pushed out of the way by someone doing it." A newer, and more pointed one is: "Knowledge keeps like fish."



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The Polaris-carrying Sub—Tribute to Design Ingenuity

• First submarine of its kind in the world, its hull is an extended version of a partially constructed sub when the Polaris program received the go-ahead sign.

GROTON, CONN—The first Polaris missile-carrying submarine is rapidly taking shape at the Electric Boat Div of General Dynamics Corp here. It will be launched this spring, and is scheduled to be operational in early 1960. Its name, decided upon recently, will be the George Washington. A companion, the Patrick Henry, also will be built here, while three others, the Theodore Roosevelt, the Abraham Lincoln, and the Robert E. Lee will be built elsewhere. Four more are authorized, but contracts as yet have not been announced. Each sub will carry a crew of 100.

All these subs will have the new shark-shape hull deemed optimum for undersea boats. One sub, the Skipjack, with this hull shape (next page) was launched last May and is being outfitted here. Design of the Skipjack leads to an interesting story about how its sister ship was transformed into the George Washington—a story explaining why we are so far ahead in construction of a pioneering missile-launching sub that was only authorized one year ago last month.

At that time the Skipjack's sister the Scorpion, was under construction here. When it was decided to build a Polaris-carrier, the Scorpion project was abruptly suspended. On the design board the Scorpion was cut in half, extended, and a 130-ft section dropped in to carry launching tubes for 16 missiles and the necessary fire control and special air-ejection system. An educated guess for some time, the Navy just confirmed the 16 launching tubes, but will not confirm that 16 missiles will be carried. A misunderstanding at a recent Congressional hearing downgraded the Polaris' range to 800 miles. The Navy denies this and says that the range is over 1200, with the ultimate range of 1500 miles expected.

There were no other major changes in design. The same-type engine and nuclear reactor used in the Skipjack are going into the George Washington. Because of her added weight, it is expected the Washington will be slower than Shipjack, whose announced underwater speed is in excess of 20 knots. Length and displacement of the Washington still is officially classified. But PE, Feb 24, '58 p 28 carried the report that these figures were 380 ft and 5400 tons respectively. The Skipjack measures 252 ft and displaces 2830 tons. These figures contrast with the Triton world's largest submarine, measuring 445 ft and displacing 5650 tons. Of conventional hull shape, the Triton has two water-cooled reactors for propulsion instead of the one to be used on Polaris subs. The Triton will be used primarily for radar picket duty on the early warning line.

Navy men argue about the number of propellers a submarine should have.

Torpedoed by Tape

"Sorry, but you can't give the length and displacement of the sub," the Navy man from Washington said. "But we printed that information about a year ago," (PE Feb 24, '58 p 28) we protested. "Sorry, but that information is still classified," he said.

Two months ago this story started on its merry way through Washington to be checked for security. Here are the stops it made:

1. Polaris Missile Management Center. Rear Adm. F. Raborn, director
2. CHINFO (Chief of Naval Information) Security Review
3. OP 51 Navy's Guided Missile branch of the Chief of Naval Operations
4. OP 31 Navy's Undersea Warfare Div.
5. Navy's Bureau of Ships
6. Back to CHINFO
7. Department of Defense Security Review
8. State Department
9. Back to the Dept of Defense Security Review
10. William Holaday, Advisor for missile and rockets to Sec of Defense McElroy
11. Back to Dept of Defense Security Review
12. Murray Snyder, Asst Sec of Defense for Public Affairs

FBM sub taking shape . . . on the ways at Electric Boat. Photo shows stage of construction last April. Superimposed sketch shows shape sub has now assumed. Missiles will be stacked behind the Sail (formerly the coning tower) as shown in Navy artist rendering (next page). The Sail is not a watertight structure. Like the Skipjack, diving planes, formerly located on the bow, are now on the sail for better maneuverability. Thickness of the hull plating cannot be revealed.

Some say two; others say one. Hydrodynamically, only one propeller is best for Skipjack-shaped hull. From the reliability or safety standpoint, two propellers are better than one. For the same horsepower, a 2-prop sub will be slightly slower than a single-propeller version.

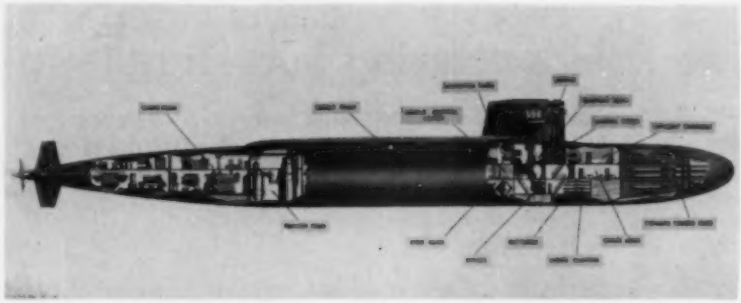
FIRING THE POLARIS

Many details of the missile launching mechanism have been shrouded in secrecy (PE—Mar 10, '58, p44). This much is known: the missile will be air-ejected from the sub so that it will clear the surface of the water. A timer will ignite the solid propellant to send the 30 ft long, 5 ft dia. missile on its 1500-mile trip. (PE–Dec. 22, '58, p. 23).

To take advantage of its skulking ability, the Washington will undoubtedly fire many of its missiles from the depths. However, there is a maximum depth (not revealed) which is in direct relation to the "push" that can be given the missile if it is to pop free of the water. Already, underwater test shots (again, depth not revealed) have sent a dummy missile 150 ft above the water, with tests to greater heights still to come.

What is not known is the distance above the water to which the missile must be ejected before it fires off. But according to some reports, no set distance above the water is required, and the missile could even be fired while it is in the water. A safe guess is that this is inadvisable, since a tremendous shock wave would be created producing the effect of a huge depth charge. When the missile is fired underwater, the danger of such a shock wave would be too great.

Missile-firing air pressures comes from the sub's compressed-air system, which is 4500 psi . . . although the Navy will not say that this necessarily is the firing pressure. One air compressor has been added to the sub's system to handle missile launching.



Interior of the Polaris sub . . . is shown in this cutaway view. Area indicated for missile storage will accommodate 16 launching tubes. Sub's anchor is mushroom shape built into the bow of the hull.

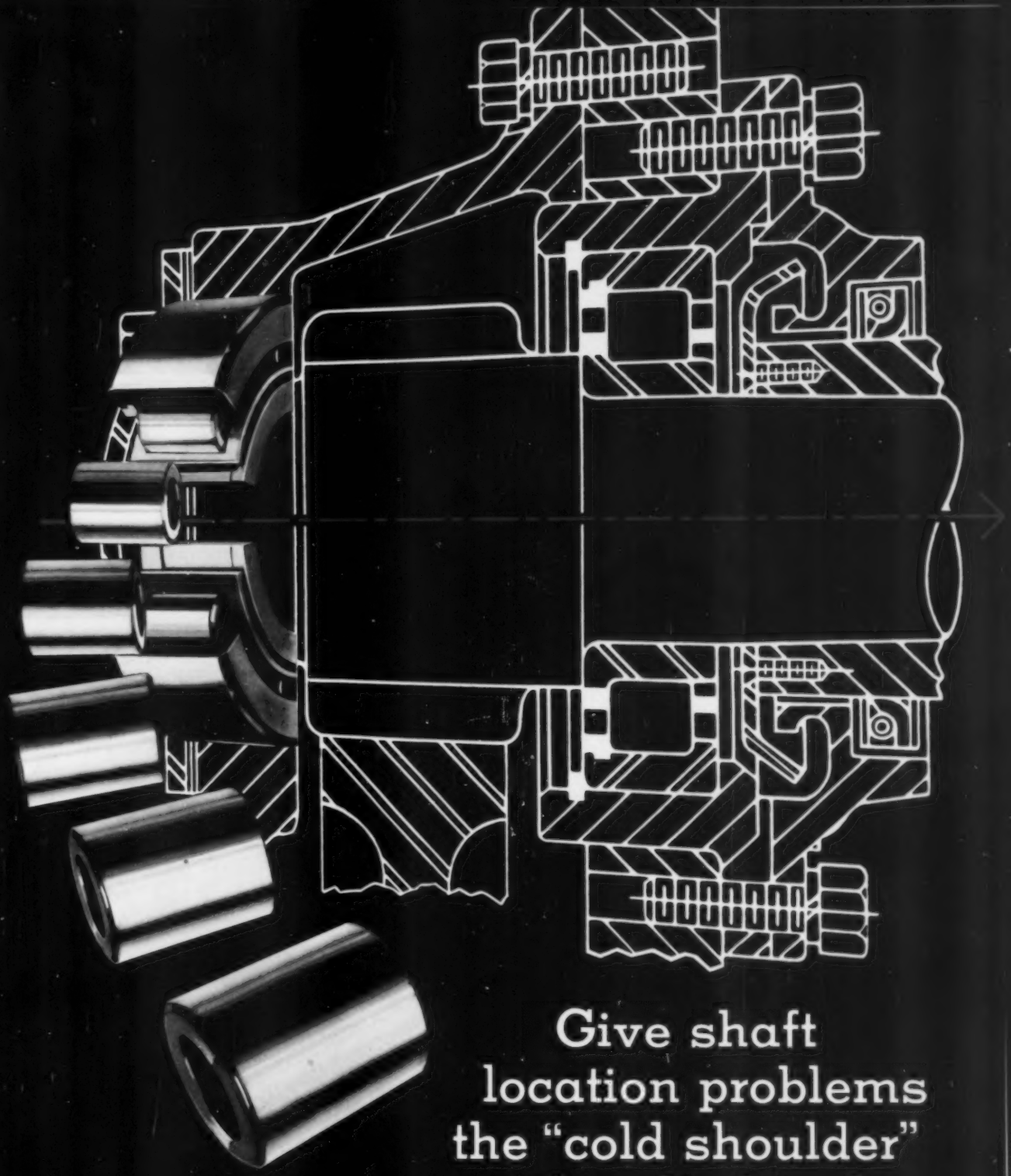
Electric Boat engineers say the air-ejection system on the sub can be compared to the catapult system on aircraft carriers, with air replacing the steam normally used on the carrier. In fact, some of the components used have been modified from the catapult system. The quick opening of a 9 or 10-in. air valve is automatically controlled from the missile fire control headquarters, but actually all that is required is to maintain the required air pressure under the missile.

Only on the surface can the missile be fired while the sub is underway. Below surface, the sub must be motionless. A gyro spin stabilizer is used to maintain the sub's altitude on the surface. This is an old principle that has not been used to any great degree at sea, according to Electric Boat, except on one Italian liner, and a pilot boat. It is a big, expensive piece of machinery, but effective, the company says. What this device will do is cut the ship's rolling to within ±5° in a state 5 sea (12-ft-high waves).

It has been reported (PE Dec 22, '58, p. 23-24) that a plastic diaphragm directly above the missile keeps the missile dry after the firing tube cover has been removed. Air pressure in the missile cylinder equalizes the outside water pressure. The missile is fired through the diaphragm. It's obvious, then, that upon firing, there is an immediate gain in weight when several tons of water rush into the empty tube. The same effect actually takes place with the firing of a conventional torpedo, only on a smaller scale. It is expected that the weight increase encountred in a missile firing would cause a fluctuation in sub depth. How to arrange the ballasting to rapidly jettison an amount of water equal to that gained when the missile has been fired posed a design problem, the answer to which is still classified. Another problem: design a system to prevent fluctuation in depth that might interfere with missile firing rate.

The fire control station aboard the sub will arm and fire the missiles. Target location and other data will be fed to the various missiles through an "umbilical" cord system. There is no actual "take-over" of the sub's operation by the fire control officer

Look-alikes . . .
The USS Skipjack (left), launched in May 1958, was first of a new class of sub built with shark-shape hull. With diving planes moved up from bow of the sub to the Sail, and a single propeller, the Skipjack's shape is not too unlike that of the Navy's first sub, the 54-ft-long USS Holland (right), which was launched in May 1897. The Holland had one torpedo tube, a pneumatic dynamite gun, a surface speed of 8 knots and submerged speed of 5 knots. The Skipjack's submerged speed has been announced as over 20 knots. Nautilus has conventional hull shape.



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location problems
the "cold shoulder"
with cylindrical

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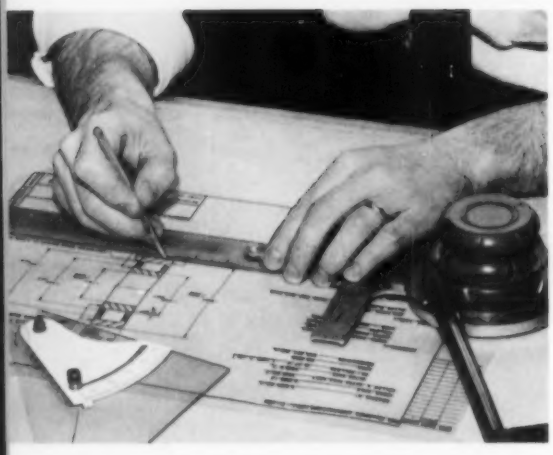
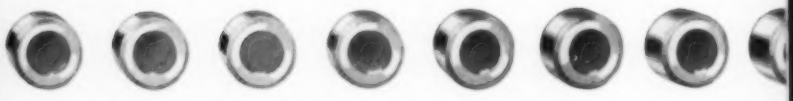
when you locate heavy shafts with

Every design engineer is familiar, of course, with the unequalled ability of cylindrical roller bearings to carry heavy radial loads. Many do not realize, however, that properly built cylindrical bearings with shouldered races *will also take thrust and locate heavy shafts dependably.*

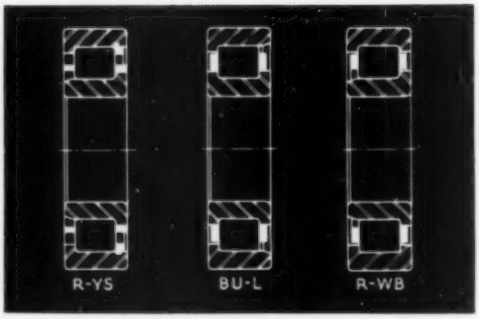
With today's trend to higher horsepowers and larger shafts, which in turn require heavier bearings, the adjustments necessary when installing angular contact bearings become





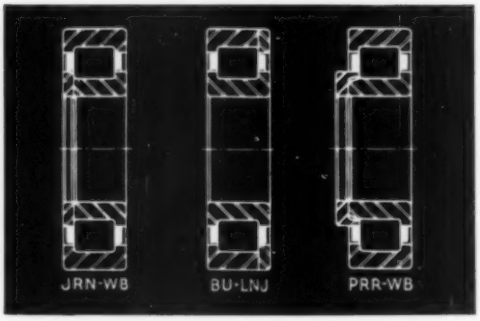
ONE-DIRECTION AXIAL SHAFT LOCATION

In most applications axial shaft location is accomplished by two opposing shouldered-race bearings, each restraining shaft movement in one direction. Depending on individual conditions, the designer has a choice of HYATT Hy-Roll types R-YS, BU-L or R-WB. Type BU-L has conclusively proved its shaft-locating dependability in applications such as engine crankshafts (Fig. 1). Type R-YS gives excellent service in final drive pinions (Fig. 2) and similar applications. All three types are normally mounted in opposing pairs, with sufficient end clearance provided in the assembly to prevent binding in operation.



TWO-DIRECTION AXIAL SHAFT LOCATION

Where the application indicates the use of only one bearing to locate a moving part axially in both directions, the designer may choose from HYATT Hy-Roll Types JRN-WB, BU-LNJ or PRR-WB. Type JRN-WB, for instance, has proved extremely successful in applications such as automobile rear axles (Fig. 3), and heavy duty truck transmission output shafts (Fig. 4). These types offer two basic advantages: (1) They provide the high load-carrying capacity of cylindrical bearings combined with two-way location. (2) They permit a completely non-adjustable fit and eliminate the necessity for shims, washers and locking nuts.



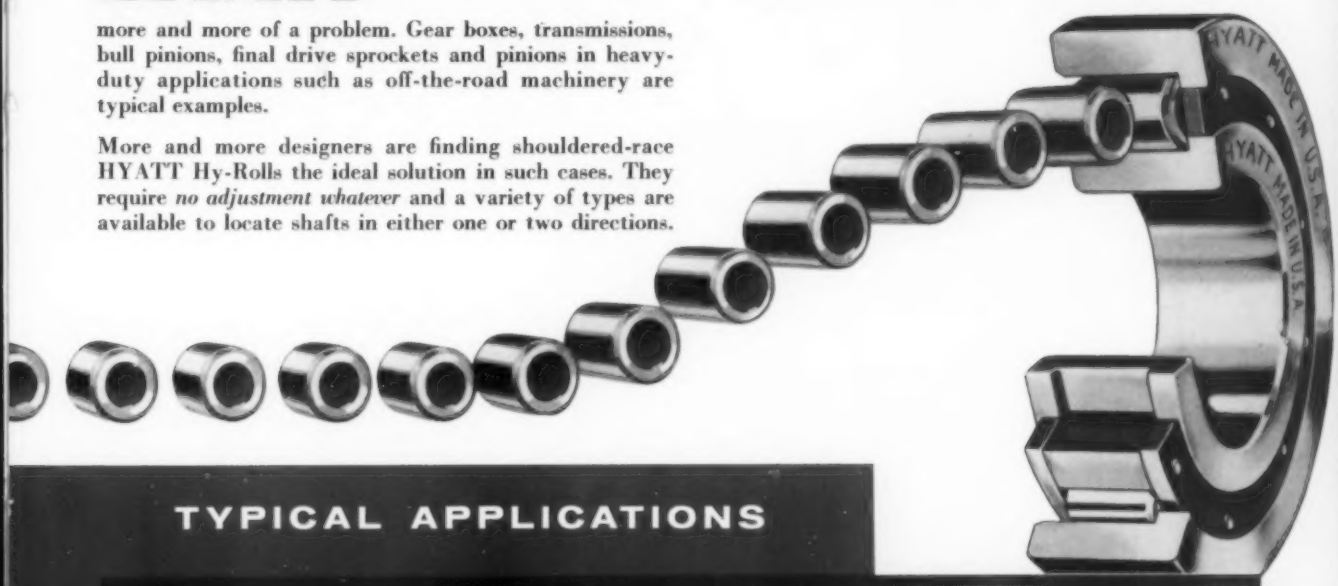
NO BEARINGS CARRY RADIAL LOADS LIKE *CYLINDRICAL*

PROBLEMS

HYATT shouldered-race cylindrical bearings

more and more of a problem. Gear boxes, transmissions, bull pinions, final drive sprockets and pinions in heavy-duty applications such as off-the-road machinery are typical examples.

More and more designers are finding shouldered-race HYATT Hy-Rolls the ideal solution in such cases. They require *no adjustment whatever* and a variety of types are available to locate shafts in either one or two directions.



TYPICAL APPLICATIONS

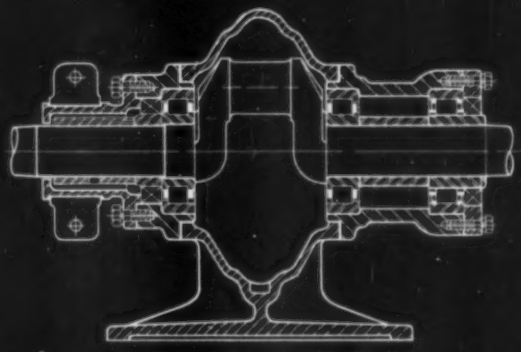


Fig. 1

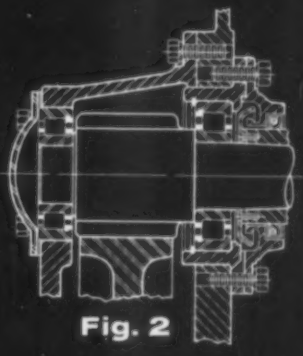


Fig. 2

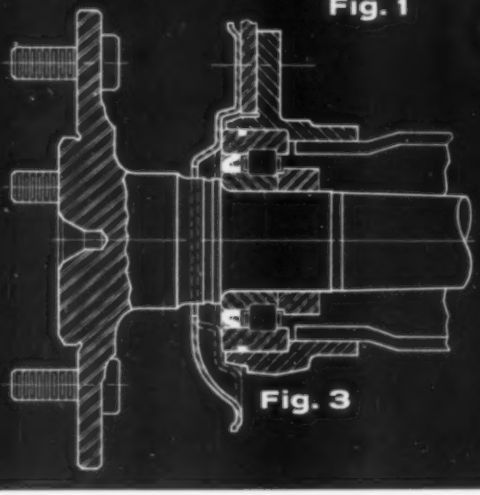


Fig. 3

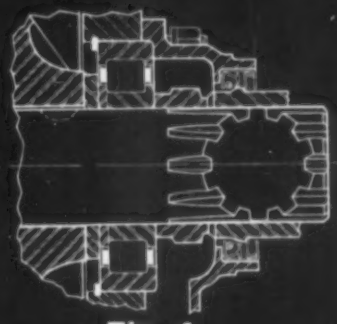


Fig. 4

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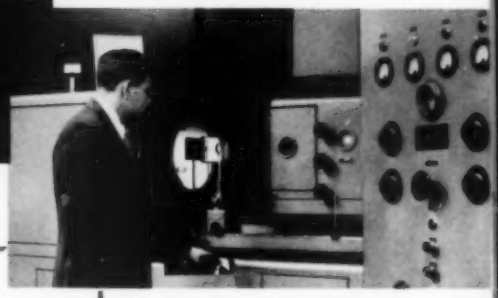
Proper distribution of load within the bearing is an important design factor which lengthens bearing life.

The finest steels must pass rigid metallurgical tests before precision manufacturing processes begin.



Remember these *BUILT-IN* HYATT Benefits:

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- Omitted races are optional
- Shaft location without sacrificing capacity
- Easier assembly and disassembly
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during the firing sequence.

The navigation system aboard the sub will be extremely accurate, for any error in the sub's position will mean a target error of that amount. The sub uses a SINS navigation system (Ship Inertial Navigation System) which is like the guidance system used on the Nautilus (which actually was a missile guidance unit). With SINS, the sub can navigate for extended periods of time without depending upon conventional external references such as radio, radar, and celestial fixes. The missile also carries a guidance system similar to the SINS unit. Both are designed by the Sperry Gyroscope Div of Sperry Rand Corp.

LIVING ON THE SUBMARINE

Navy and civilian project officers at Electric Boat say that by the time the Polaris-carrying subs become operational, oxygen and air-purifying equipment will be available that will permit sub crews to stay down indefinitely.

Limiting factors will be the room needed to store enough food for a long trip, and ability of crew members to tolerate each other in such a confined space for extended periods of time. New equipment going on the Washington will work on the electrolysis principle to extract oxygen from sea water. The Sea Wolf, which set an endurance record by remaining submerged for 60 days, used reserve oxygen tanks. Work on Air Habitability in subs can be translated to the future. In fact there has been extensive liaison with the space flight people also faced with these problems.

PARALLEL DEVELOPMENT

Electric Boat says this first missile-carrying sub's interior construction and design, particularly in the missile launching and control section, is unusual in that its design is progressing at the same pace as the design of the guidance and launching system. With the exterior dimensions of this area already set, the requirement now is to shoe-horn all the necessary equipment into the space allotted for it.

Much of the design of the new sub was predicated on many assumed (hoped for) engineering breakthroughs. While a missile-carrying sub had been conceived some years ago, it was the successful development of a good solid rocket propellant that gave the program the green light.

Use Single Nozzle Epoxy Gun with Sprayed Fiber Glass

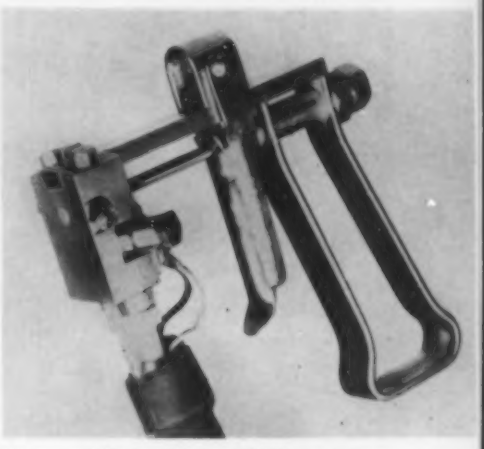
CHICAGO—A single-nozzled spray-gun (right) designed to make epoxy resins more competitive with cheaper sprayed polyester resins in the reinforced plastics market (PE—Jan. 13, '58 p 17-19) was announced at the 14th Annual Exhibit and Conference of the Reinforced Plastics Div of the Society of the Plastics Industry, Inc.

The process was described by A. Paul Limbach and J. J. Madden of Union Carbide Plastic Co's Development Laboratories. They made it plain that epoxy makers are counting on the new process to boost epoxy in the pleasure boat market, now dominated almost entirely by polyester resins. The pleasure boat market currently is the chief outlet for reinforced plastics—and is gaining ground.

Limbach and Madden said that while epoxy resins have good adhesive qualities, chemical resistance, fatigue strength and the ability to cure at room temperatures, their development has been held back by the fact that they are more expensive than polyester resins (62¢ per lb for epoxy, 33¢ for polyester). Also, to obtain reasonably short periods of cure, epoxy systems have to be mixed which have short pot lives.

Describing a commercial process for epoxy boats which eliminated some of these problems, Limbach and Madden pointed out a new epoxy spray gun, developed and marketed by A. Gusmer, Inc, Woodbridge, NJ, now used by Northwest Mfg Co, Iron River, Mich, to manufacture 12½ ft sport boats of epoxy resin and glass fiber. They said the 80-lb boat had been made competitive with other plastic boats as a result of the Gusmer gun.

In addition, to replacing polyester with epoxy resin, according to Gusmer, the development differs from the Rand Development Corp process (see above back reference) in that the Gusmer gun eliminates bulk mixing by allowing continuous mixing. Resin and hardener are fed into the gun through electrically-heated hoses and blended under centrifugal force in a mixing chamber within the gun —in the Rand gun, blending occurs



after catalyst and accelerator are sprayed from gun—resin and hardener are then atomized in the process of ejection under 300 psi pressure. As compressed air is not used, toxicity hazard is reduced.

Limbach and Madden said systems which cure in as little as 30 sec can be used, and by combining the epoxy gun with a glass fiber cutter—similar to that used in the Rand gun—made by I. G. Brenner Co, Northwest Mfg Co, was able to build its boats by spraying the plastic resin and the reinforcing material onto the mold in a simultaneous operation.

Soviet Educators Report on 3-Week Visit Here

NEW YORK—Five Soviet engineering educators spent three weeks visiting 8 US universities and institutes to inspect academic and R & D facilities as guests of the American Society of Engineering Education and our State Department. During a recent 90-minute press conference here, their spokesman, Prof Panteleimon Lebedov, machine building chief of USSR's High Technical Schools, offered these reactions:

1. Soviet education of undergraduate engineers better prepares students for specific field of activity in industry. There are 250 engineering study categories as compared to US's 20.

2. US graduate school programs

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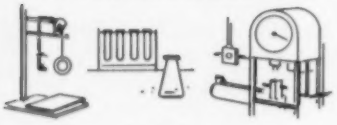

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seem to provide broader base for eventual entry in fields of R & D. USSR's program is too narrow but they're taking steps to remedy it.

3. US education gives the student greater range in basic R & D, USSR has edge in applied R & D.

4. There is a shortage of engineers in Russia, particularly in electronic and computer technology.

5. Soviet engineer student chooses from 10 broad engineering fields for the first 2 years of study—then must make a choice—which is irrevocable for him—from amongst the 250 categories.

6. Soviet student carries a heavier workload than his US counterpart.

a) In USSR, engineering undergraduate puts in equivalent of 6 years study for a degree, including ½-year credit for an 18-month on-the-job period when he also studies nights.

b) Soviet student puts in longer work week–about 30% more–in classroom than the US student during first 2 years. After that, work weeks are about the same. US and USSR semester are approximately the same length.

7. Soviet engineering professors more often than not serve additionally as consultants to industry and are compensated in proportion to their contribution.

8. In US, professors are freer to organize courses to suit needs of future. In USSR, studies are attuned to immediate needs of industry and ministries.

See Engineers Solving Space Medical Tests

RANDOLPH AFB TEXAS—Engineering advances will probably make it possible for a man of average physical endurance to get into space, Dr. Fritz Haber, Lycoming Div., Avco, told a gathering here to commemorate the 10th anniversary of the Dept. of Space Medicine. At present, medical specialists are accumulating data on body tolerances and setting standards for selecting the unique man capable of such a trip. But, Dr. Haber predicted, someone in his audience would make the trip without meeting these severe standards.

Just what the engineering advances will be, he said, is impossible to predict. But he foresees the possibility of reducing rocket accelerations by increasing exhaust velocity to the point where the average man can withstand the G forces.

At present, he noted, rocket weight on launching pads is mostly fuel. As fuel burns during flight, rocket weight decreases and the remaining fuel accelerates the lighter vehicle at a continuously faster rate. By burnout, a hypothetical single stage 150-ton rocket would be accelerating at 30 g's. Staging complicates reliability but will keep acceleration at the threshold of human tolerance in initial manned space flights.

Possibly, application of magneto-hydrodynamic effects will make it possible for engineers to increase exhaust velocity and reduce fuel requirements substantially. In magneto-hydrodynamic effects, gasses at very high temperatures ionize and become electrical conductors. Magnetic forces can then be used to accelerate the gasses.

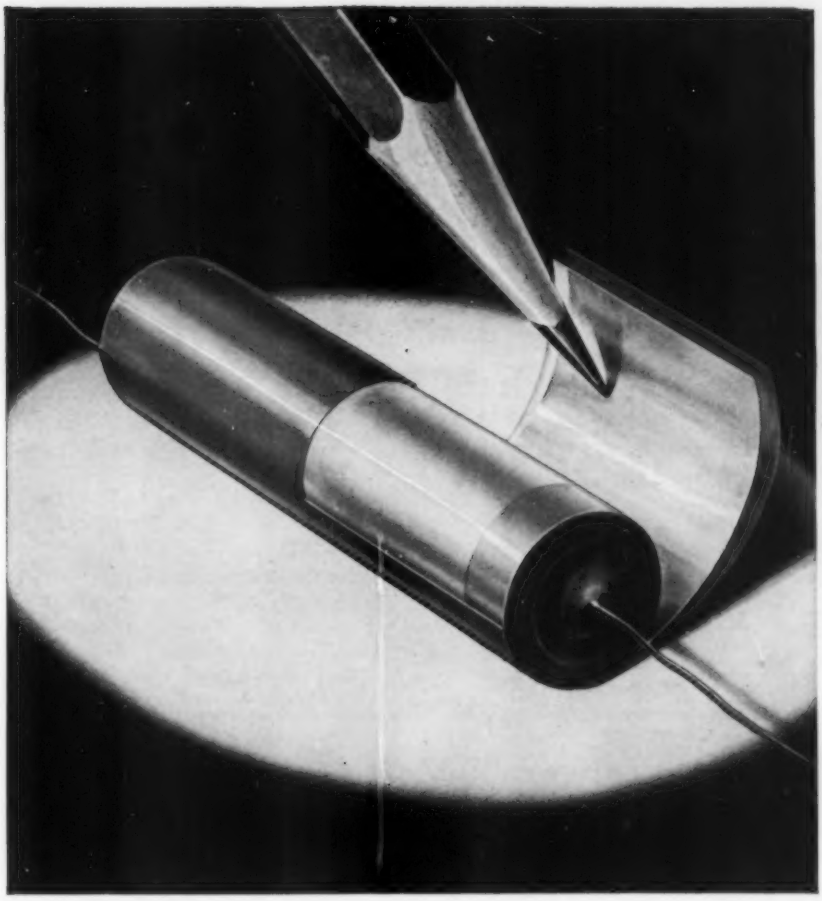
US Engineer Student Enrollments Decline

PRINCETON, NJ—Enrollment in American engineering schools is on the decline. Only recently Princeton University, noting the fall-off in engineering enrollees, dropped its limitations on the number of students entering this field; will seek instead to boost such enrollments to 20% of the student body.

According to the American Society for Engineering Education, the 153 accredited engineering colleges in the US had 2.9% fewer students in the fall of '58 than in the fall of '57. Also, the freshman class which entered in the fall of '58 was 11.6% smaller than the incoming engineer frosh in '57.

Figures, obtained from an annual survey conducted by ASEE in cooperation with the US Office of Education, showed that engineering studies are now less than 7% of all US college students as compared with 8.5% in '57. Enrollment of 2nd-year students is down 6%, and 3rd-year down 4% from the previous year. However, in the 4th and 5th-year levels, enrollments this year equal last year.

Graduate study in engineering continues to increase sharply, and enrollment is now at record levels, according to the ASEE Office of Education figures. This fall 27,456 students were enrolled in master's degree programs, an increase of 14.7% over 1957; and 4,762—up 14.3%—were studying for doctor's degrees.



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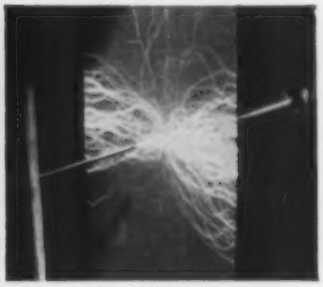

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Western Electric reports . . .

Du Pont MYLAR® cuts capacitor costs

PROBLEM: Western Electric was searching for a dielectric material which, when used in film-foil construction, would lower manufacturing costs.

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RESULTS: Capacitors insulated with "Mylar" provide excellent performance for selected types of equipment produced by Western Electric. These new capacitors achieve high reliability and long life. Materials savings have been realized through reductions in size and use of less costly encapsulation.

HOW CAN "MYLAR" HELP YOU? Whether your product uses miniaturized capacitors or heavy-duty cables, it will pay you to investigate the performance benefits of "Mylar". . . and products made with "Mylar". Component makers find this tough, thin polyester film will often cost less on an area basis than present insulating materials. For more detailed information, send in the coupon.

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Specialized consultants aren't thirsty for expense accounts or fringe benefits, and sermons on teamwork leave them cold. But, they say, advantages of going it alone far outweigh disadvantages—if you've got what it takes.

C J LYNCH *Assistant Editor*

"There's a race of men that don't fit in," wrote Robert W. Service, the frontier poet and backroom ballader. And among engineers, independent consultants perhaps belong to this breed. It's more than being a little above average in talent. Their motives are different . . . their attitude is different . . . their goals are different. In these times when most other engineers seek the security and stability of a large corporation, these rebels dodge group creativity, team-oriented business, and a slot in the organization chart. They prefer a basement-size engineering department, independence and the risks of private enterprise.

"I'm a kind of maverick," says one as he tips his chair away from his workbench and clasps his hands behind his head. "I don't work a 9-to-5 day, and of course don't get that regular pay-check at the end of the month. My fringe benefit is the satisfaction of doing the work I want to do, the way I want to do it. It's flattering to think there are companies who will pay me so I can live this way. Some people won't like it. But to me it's exciting—I never know who will call me next or what his problem will be."

The consultant idea, of course, is not a novelty in engineering. Large consulting firms have been around a long

time. These are the corporations that supply engineering talent to build bridges and vehicular tunnels, install powerplants and hydro-electric projects. These are consultants in the classical sense–as familiar to the public as they are to the engineering profession.

The engineer's engineer

But in this age of specialties, a new kind of consulting engineer is beginning to emerge. He is the independent who through publicity in engineering journals and society meetings, has acquired a reputation as an expert in a narrow field of engineering–and has capitalized on it. He may rent a room in an office building or he may operate out of his own home; he may make considerable money . . . or he may starve.

Independent consultants can be grouped broadly into two classes. There are those to whom consulting is only a part-time job–perhaps a natural appendage to their work as university professor. They don't rely on it for a livelihood–it's simply a welcome and often challenging source of additional income. They aren't subject to the fluctuating whim of supply and demand–their salaried main job is a hedge against variations in the freelance market.

The other type is an all-out entrepreneur. His sole source of income is the consultant service he can sell. In his firm he is the president, vice-president, sales manager, engineering staff, bookkeeper and shipping clerk.

Sheer engineering competence . . . plus

Versatility, and freedom from confining procedures are the attributes that distinguish him from his fellow engineer. But what other qualities are needed? Engineering competence, of course, is basic. To the independent consultant this means experience, years of it, and a reputation in his established field. For this reason younger engineers have a harder time of it than the older, better established engineer. But a young man with special training is one of the new, fast-growing fields can command respect too.

Salesmanship appears to be the second most desirable quality. "The ability to sell a customer and keep him sold makes the difference in whether the consultant will eat tomorrow," a gear expert explains. Then he adds, "It is also the quality most likely to be lacking in an engineer."

These traits–versatility, engineering ability in a chosen specialty and sales ability that flows from a kind of infectious enthusiasm–are perhaps the only qualities found in common among these individualists. Their specialties, work habits, even the ways they make money or contact clients, vary from man to man. As might be expected from a group unfettered by red tape and controls of a larger organization, they find the pattern that suits them best and bet their brains and bank account that the services they offer will be marketable.

Easy does it

Putting yourself in business isn't nearly as simple as it looks. To hang out your shingle and wait for someone to knock on your door, said one man candidly, "is probably the most certain, and surely the dullest path to bankruptcy you could choose." Advertising is not much good either (aside from the matter of dubious ethics). Most independents don't even bother to list themselves in the yellow pages of the phone book. This field is so small, so new, and so fluctuating that most of the men aren't even listed with their engineering society.

Usually an engineer gets into the consulting business slowly and cautiously–almost accidentally. The first job may come through a friend or business acquaintance and is done on a part-time basis. Then, somewhere during the middle of the second part-time job, he starts feeling that on the strength of his reputation and the broad application of his specialty, the consulting work will support him full-time. (But watch out, warn those who have tried it; the first two years are the hardest and it's best to have some source of independent income.)

After he becomes a little better established, he will probably want to keep several jobs going simultaneously. Contacting new clients may develop into a sizable part of his job. Friends, previous employers, vendors on a previous job, and engineering societies are all good sources. Ringing doorbells of companies that have products related to his specialty is another common technique. Fortified with a scrapbook of published papers and lists of his patents, he hopes to get placed on the list of qualified consultants when a problem in his specialty arises. Some independents send reprints of their by-lined articles to a carefully chosen list of potential clients. One man has an interesting gambit. He scans employment ads for companies trying to hire full-time employes for a job he could do part-time –then sells the company on the idea.

Keeping that wolf from the door

Most well-established one-man consulting firms have at least one or two steady clients who pay them on a retainer basis. A research physicist, for example, is on retainer to two large corporations which he visits perhaps once or twice a year at most. He spends the rest of his time at home, in his laboratory–or at his desk doing undirected research which may or may not lead to something profitable for his two clients. Does he do work for other companies too? "Well," he says, "my clients don't deny me that opportunity, but I don't invite any more work. I can keep busy just working for these two."

Another man, a metallurgist, works for 14 different noncompeting companies which he visits once or twice a month. His office is in the basement of his home located in an attractive suburb. He's been an independent con-

sultant 12 years. In his spare time he teaches, writes books and technical papers. He works hard: lives comfortably.

Why does a company hire an independent consultant? First, and most common reason: a small company requires specialized knowledge to supplement its engineering effort but can't afford to hire a specialist full-time. Even large companies, with many such specialists already on the staff often need an outsider with recognized competence. The consultant offers availability, a fresh viewpoint and sheer engineering competence derived from years of experience with many wide-ranging problems in a narrow specialty.

The other common reason: extra help when the engineering department is overloaded. Most consultants prefer to avoid this type of work–it's too confining, too much of the routine they were trying to avoid when they launched into private practice. But for the employer, they are a good buy in such situations. They involve no overhead, no fringe benefits, and are not a permanent addition to the payroll to be carried when the need is gone. On an hourly-wage basis they are most expensive, but this is not a fair comparison–the full-time staff engineer costs more than twice his base pay in overhead.

Baggy pants no liability

When called in on a job, consultants may be put to work several ways. Those who make regular visits on a retainer usually spend a day talking with the men in charge of various projects. The job of these consultants is to keep efforts on the right track, point in new directions and assure management that money is not being drained away on projects with little merit. Sometimes they are given an office for the day and are visited by people bringing technical problems. "It's a rewarding experience," says a servo-systems expert. "Maybe you were up nearly all night on a previous job. You have a two-day growth of beard, your pants are baggy, shirt open at the neck, but they don't care–you're an expert. They literally line up outside the door. Vice-presidents run to buy your coffee. They pick your brains, you tell them what you know and they are apparently grateful. At least they continue to pay you to come back."

Another common arrangement is to get called in on a particular problem. It may be to design a small gearbox for a particularly ticklish application. In such cases, the consultant usually gets an exploratory contract–this gives him a chance to make some preliminary calculations and estimate what the bill will be. "Performance is what the company wants," consultants stress. "They want that gearbox and they want it within a specified period of time. They don't care where you get the information–books, manufacturer's data, other consultants–it doesn't matter. Performance is what they want and what they pay for."

Because many clients like to get a production prototype on completion of the job, some men find it convenient to maintain a small machine shop and testing laboratory. And those who have invented a specialized device with a limited market may also have a small production shop. In some cases, the consulting service functions mostly as a sales gimmick. If the application calls for it, he may recommend his patented device and offer to custom-tailor it to the job.

Writing articles for trade publications and technical journals is not a very fat source of income. But the consultants do it–mostly to maintain status in the field. Or, in some cases, the consultant will write an article relating to some specialized work he has done for a company. The article is then published under company auspices, for company publicity; the consultant collects the standard author's fee plus a handsome bonus.

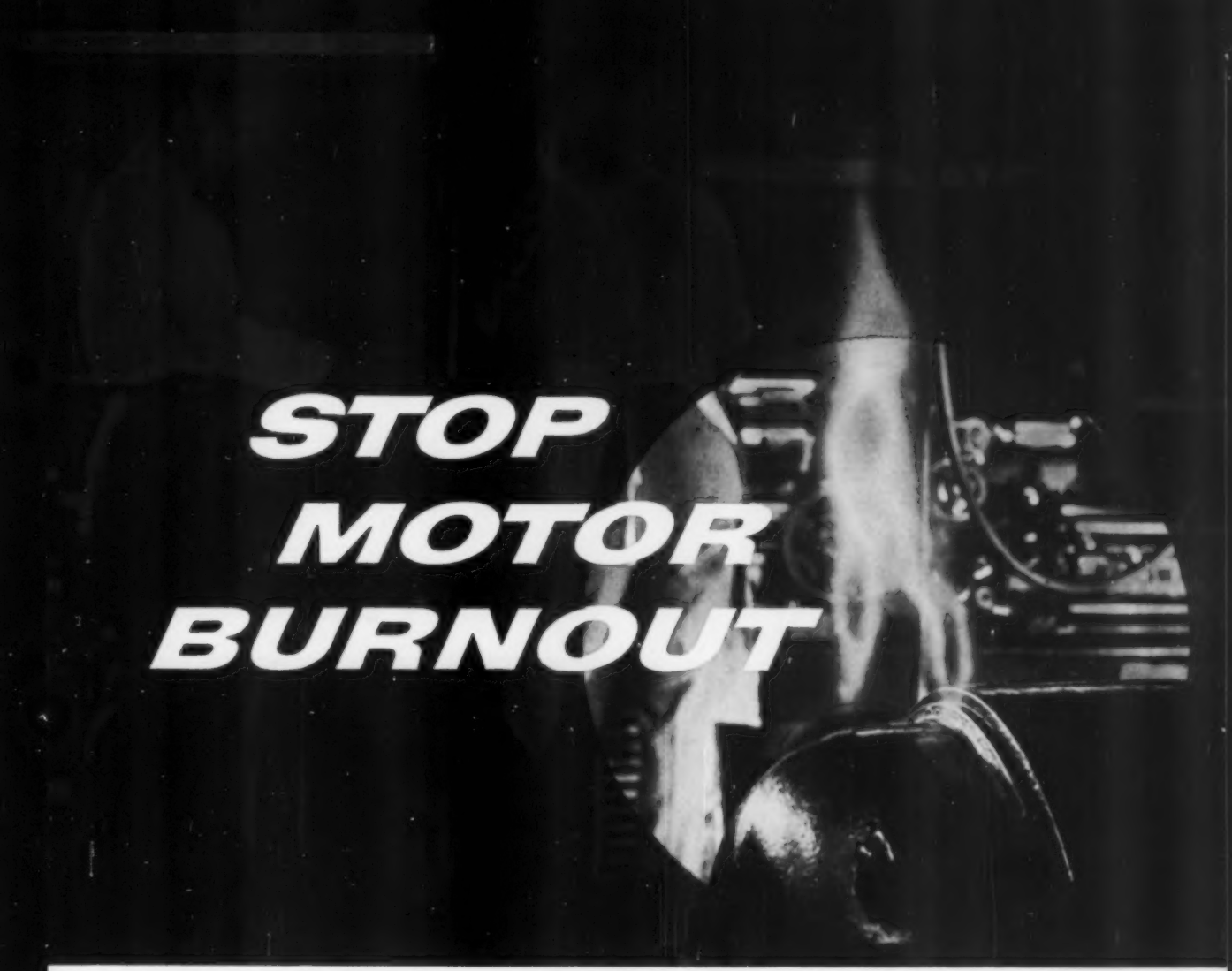
Growing pains for private enterprise

The independents are first to admit that they are not working in utopia. It requires an unusual kind of personality to get into the business and make it pay, they say.

Here are some of the things established consultants list when questioned about factors they underestimated or mistakes they made early in the game:

- It takes time to get established. There will be plenty of rough sledding the first couple of years. It's best to have some money saved up, or some source of independent income to carry you through the slack months.
- Don't forget that expenses are your own. If you take a trip to a society meeting, it comes out of your own pocket. And there will be no group insurance plans or provision for sick leave either.
- A one-man firm has difficulty getting catalogs, company literature, trade magazines. A time-clock man can usually get such things through the regular channels.
- Don't spend so much time on one project that you lose touch with what the rest of industry is doing. The facts a consultant gleans from a wide variety of sources are his stock in trade.
- There are times when you won't get the personal satisfaction of finishing a job you've started. If your recommendations are modified or misinterpreted after the situation has passed out of your control–you are blamed anyway.
- Don't undercharge for your services. Operating costs are greater than they appear at first glance and your workload has cyclical fluctuations. You are a specialist and you should charge accordingly. Fees for consultants vary and are of course, tied to the general economic picture. A daily charge of $150-200 is about average at present.
- Don't overestimate the potential market. One of the first things a company cuts when it begins to get economy-minded is service of this type. During periods of economic stress, the company may want to continue the relationship on a minimum basis but this is not very satisfactory. The consultant may not mind starting on a minimum basis–this is customary. But he anticipates the company will want more of his time when it gets deeper into projects he has suggested. If he is a top-notch man and has done a good selling job, he needn't worry. ■

CIRCLE 62 READER SERVICE CARD →



ASCO Close-Differential Relays provide dependable, low-cost protection from under and over voltage.

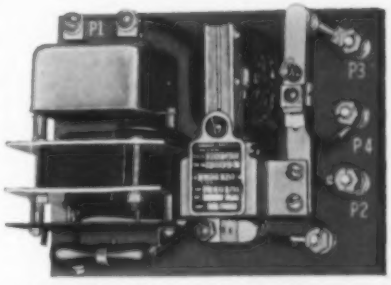
When a motor runs on low voltage for an extended period of time, burnout and fire may result. This can be costly in both down-time and damage to equipment.

You can protect your motors with ASCO Close-Differential Relays. They offer economical, dependable protection even when motor feedback conditions prevent ordinary potential relays from detecting changes in voltage. ASCO Close-Differential Relays respond to a 2% variation in voltage; protect motors when low voltage or over voltage conditions occur.

Because they combine sensitivity with rugged construction, ASCO Relays are providing low-cost protection in a wide variety of applications.

For example, in some oil burner installations, ASCO Relays help prevent explosions due to under voltage. In these installations, when under voltage occurs, ASCO Relays prevent oil build-up in the pit by detecting this low voltage condition, and causing oil flow to be cut off immediately. Otherwise on under voltage the oil would build-up in the pit since the ignition system would not fire. This excess oil could result in an explosion when voltage is restored and the ignition system fires.

Find out how the ASCO Close-Differential Relay can protect your equipment. Send for Catalog 57-S4 describing the complete line of ASCO Relays.



ASCO Close-Differential A-C Relay operates on 2% variation in voltage—features positive action, quiet operation, power relay type contacts.

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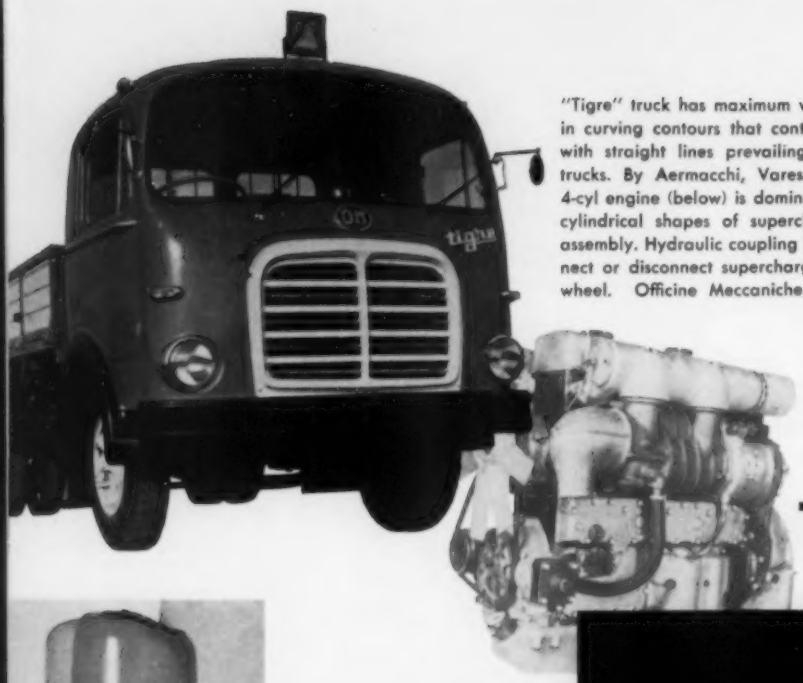
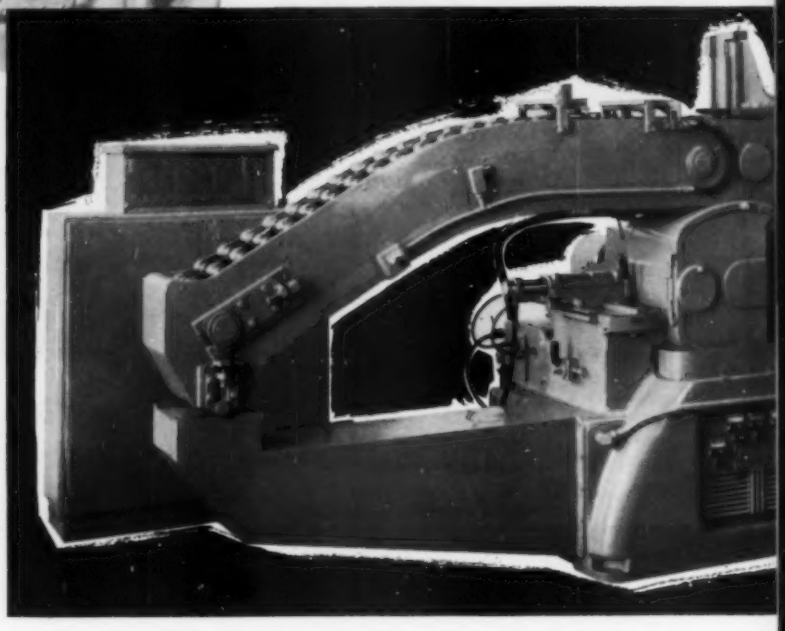
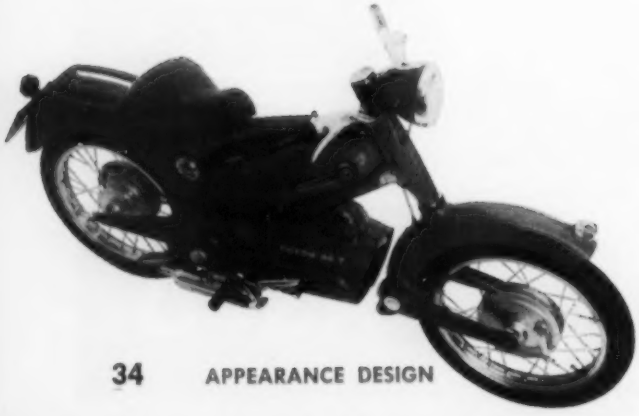


"Tigre" truck has maximum window area, set in curving contours that contrast sharply with straight lines prevailing in American trucks. By Aermacchi, Varese. The 135-hp, 4-cyl engine (below) is dominated by heavy cylindrical shapes of supercharger-manifold assembly. Hydraulic coupling lets driver connect or disconnect supercharger while behind wheel. Officine Meccaniche, Milan.

TRENDS

Dissimilar profiles of front and back metal housing sections aid ventilation through integral vents of gas-fired water heater; absence of fastenings makes it easier to clean. Designed by Alberto Rosselli, Milan, for Societa Industriale Misuratori. Motorcycle's engine and carburetor has air-duct type housing, a reason why it suggests Italian racing car design. Designed by Piero Remor, Rome, for Motom Italiana, SPA.

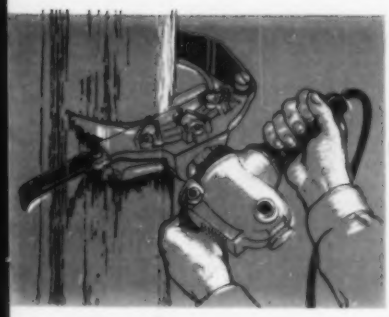




■ Italian industrial design is a post-war development—yet some already compare it with the artisanry of the Renaissance. And as in that great era of Western art, science and engineering, Italy is again establishing influential trends.

Main source of inspiration at first was the US. But the actual Italian movement was spearheaded by two native industrialists. Necchi and Olivetti, makers of sewing and business machines, used industrial design to woo export markets. Today they engage freelance designers and also maintain their own design staffs. Even Italy's major department-store chain, Rinascente, actively supports and encourages industrial design. This company's "Compasso d'Oro" and other awards go annually to those individuals and groups—Italian and foreign—who have advanced the profession or introduced outstanding creations.

But it is the rest of Italian industry that will probably most influence future development. These manufacturers sell primarily

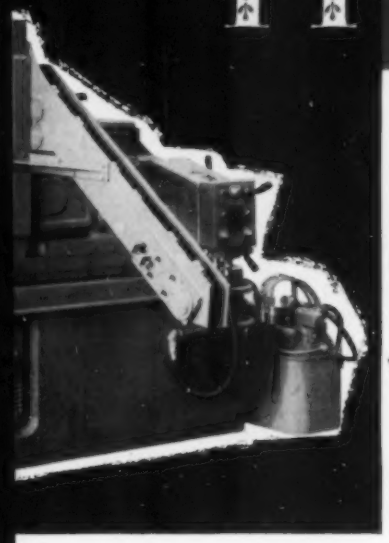


Drive is transmitted to portable annular saw's circular blade by tapered wheel. It is forced against blade by roller inside housing. Visible rollers and bearings minimize wobble. Tightly wrapped housing helps keep weight down to 13-16 lb. By Seghe Santilli, Campobasso.

Vacuum cleaner stands on end, can be pulled along floor on its side, or can be carried—either by hand or slung over shoulder. Designed by A and P G Castiglioni, Milan, for Rem.

in appearance design . . .

ITALY



Adding machine's plastic housing tends to match hand contours occurring when lifting and moving. Key rows are sloped to fit finger lengths and movements, reducing wrist strain. Designed by Fabbio Mello, Milan, for Elmis, SPA.

Lines of centerless grinder's automatic loading bridge and unloading conveyor are repeated in base and elsewhere, giving machine over-all look of unity and simplicity. By Giustina, Milan.

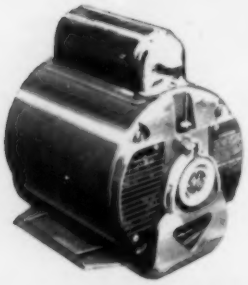
to the domestic market, facing little foreign competition as yet. Also, many firms are still run by the families that own them—often a brake upon the imaginative engineer and designer. However, the imminent European Common Market and other developing international trade agreements should bring in new and lively competition—while broadening markets for the domestic manufacturers.

As elsewhere, capital goods lags behind consumer product industries in applying good design principles. But Italy's industrial-equipment companies are beginning to realize that they, too, must satisfy demand for good looks and functional organization of controls and other machine components. So far, the design staffs working on heavy machinery are not accorded individual credit for their design work.

Among Italian designers who have been winning international recognition are: Marcello Nizzoli, designer for both Necchi and Olivetti; Marco Zanuso, who does work for Borletti sewing machines; designer Pinin Farina of the automobile world; Alberto Rosselli, editor of Italy's industrial design magazine, *Stile Industria;* Gio Ponti, designer of the new Time-Life auditorium in New York.

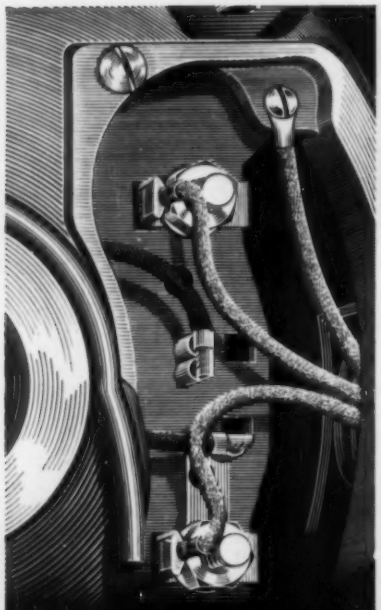
Yet despite their accomplishments, Italian designers feel their professional status lags behind that of a number of other European countries. Their professional society of 130 members, the ADI (Associazione Disegno Industriale), is only two years old. Italy's first courses in industrial design began last fall at Milan Polytechnic's School of Architecture.

Italian designers, engineers and manufacturers agree that their main objective should be a reduction in production costs, achieved through functional simplicity. But their products are mostly designed for a limited market—and without annual changes in style as in the US. Therefore most Italian products are still dominated by a formal, traditional design approach. ■



Here are 6 Reasons why

REDUCE

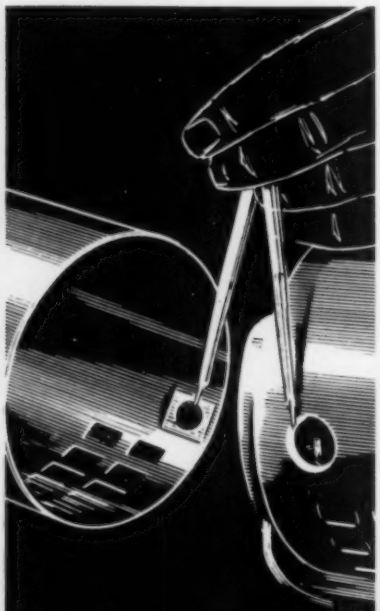


EASY TO HOOK UP

This enlarged wiring compartment saves hook-up time on the assembly line

Wiring compartments on G-E motors are now roomier and easier to work with. An enlarged opening allows greater accessibility. A narrower terminal board makes it easy to bring in leads from conduit. There are no extra studs on the board to result in "hook-up confusion." Easier, more accurate wiring results. How much can this extra value save you?

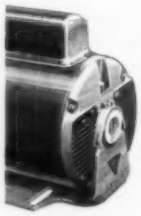
GENERAL ELECTRIC



FAST CONDUIT CONNECTION

Special speed nut permits conduit connection from outside; cuts connection time 50%

Conduit connection is greatly simplified by single-thread speed nut welded inside the motor shell. This feature permits connection of conduit from outside the motor in half the time normally required with conventional lock nut. No waste of time fumbling with a loose nut, no possibility of dropping it in the motor or on the floor. It's a real time saver!



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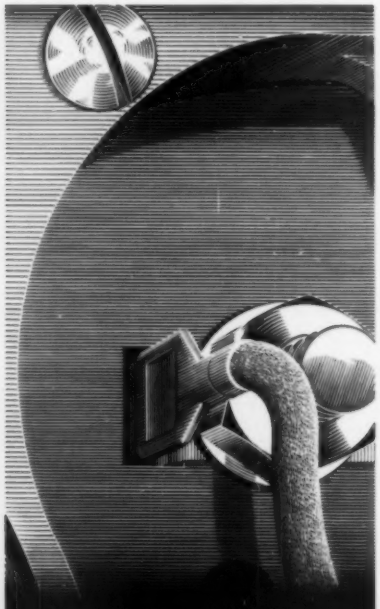

FAST LEAD CONNECTION

Now plug-in connectors on all terminals cut wiring time in half

For the first time on all single-phase Form G motors, General Electric offers time-saving quick connectors on *all* external and internal contacts.* Wiring time is cut in half. (Studs have been retained for conventional wiring.) Simply plug in the leads. Fast, positive connections are assured. Try it yourself. You'll like this new General Electric extra value.

* Explosion-proof and a few special motors excepted.

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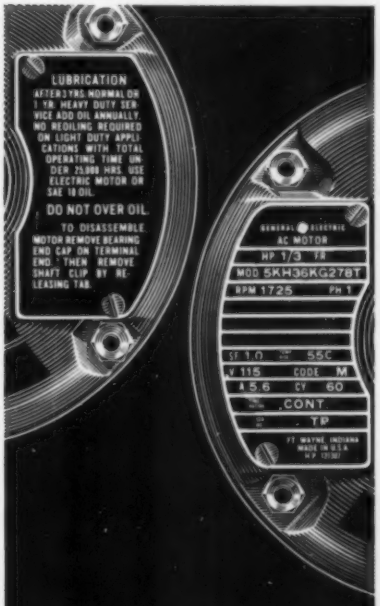
JUST ASK YOUR GENERAL ELECTRIC SALES ENGINEER

General Electric Form G motors . . .

ASSEMBLY TIME


LUBRICATION
AFTER 3 YRS. NORMAL OR 1 YR. HEAVY DUTY SERVICE ADD OIL ANNUALLY. NO REOILING REQUIRED ON LIGHT DUTY APPLICATIONS WITH TOTAL OPERATING TIME UNDER 25,000 HRS. USE ELECTRIC MOTOR OR SAE 10 OIL.
DO NOT OVER OIL.
TO DISASSEMBLE MOTOR REMOVE BEARING END CAP ON TERMINAL END. THEN REMOVE SHAFT CLIP BY RELEASING TAB.
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MOD 5KH36KG27BT
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55C
V 115
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CY 60
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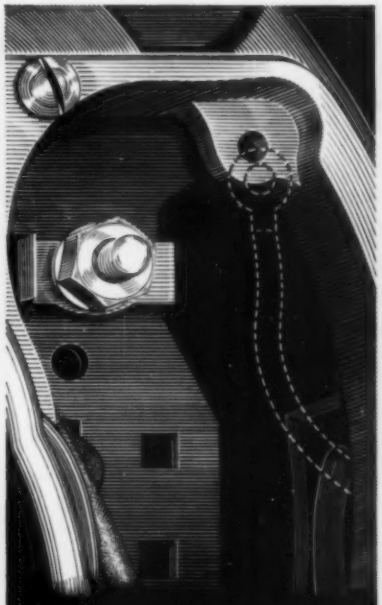
EASY-TO-READ NAMEPLATES

New permanent instructions and data simplify installation and servicing

Operating data on Form G motors is both legible and permanent to help you select, install and service without guesswork. The nameplate is engraved, then paint-filled for extra readability. Oiling instructions are lithographed on the terminal box cover plate. Lets your customers know exactly how *little* maintenance is required. *See* this extra value!



SAFE, SIMPLE GROUND

Built-in grounding lug permits fast, easy grounding to meet UL standards

Now on Form G motors you get a built-in grounding lug that meets UL standards for grounded third lead when required. With a self-forming screw you can make ground connections quickly, easily and inexpensively. This feature assures safe, permanent grounds. There's no chance of disconnection during maintenance. Ask for details on this extra value.

COMPACT, LIGHTWEIGHT

Small, light Form Gs easy to assemble; cut handling and shipping costs

Up to 50 per cent lighter, 40 per cent smaller than old-style designs, General Electric Form Gs are easier to handle, faster to install. Compact motor requires less mounting space and material; cuts down "assembly-line fatigue" caused by heavier motors; reduces stock space and shipping costs. You can't help but ***save*** with compact, lightweight Form Gs!

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GENERAL ELECTRIC GENERAL ELECTRIC GENERAL ELECTRIC

ABOUT THE NEW FORM G "EXTRA VALUE" FEATURES

POINTS OF

THE QUESTION:

"How do you Get Information from Foreign Technical Publications?"

"The real problem . . .

is one of selection. A vast flow of information—technical, scientific, and economic—is available from open sources. It's easy to criticize people for not taking enough advantage of this, but the quantity of literature available, both domestic and foreign, is so great that considerable judgment must be used to screen and classify it. Otherwise, you're swamped.

"The reviewer-translator must key his work to the user's needs, particularly in regard to the degree of specialization, so that he can give the proper depth in a report or abstract. People who regard the problem of obtaining access to information published abroad as one of translation alone are oversimplifying. We are not buying just a verbatim translation—we're buying judgment and ability to evaluate material in terms of its interest to us. The flow of information is so great that a person could spend all his time trying to keep track, with none left over for evaluation.

"We are using the services of several consultants, each usually being concerned with a specific area of interest. We ask the consultant to collect information in a specified area of science, engineering, physics or economics. Often, this is done during a trip abroad for work or study.

"Personal contact is still one of the most valuable sources of information. Participating in professional society activities, talking to people face-to-face helps many of us to keep up with recent developments and anticipate future trends. If you've missed something important in your efforts to keep up with foreign developments, you're almost certain to find out about it when you start 'talking shop' with others in your field."

DR JAMES E LIPP
Corporate Director of Development Planning
Lockheed Aircraft Corp

DR FRANK B SMITH
Technical Director
Dow Chemical International Ltd, SA

"To keep oneself informed . . .

about technical developments on an accurate and up-to-date basis is a complicated process. In many large companies it gave rise in recent years to a new corporate function, that of technical-data processing. With technical information from foreign sources this process is doubly difficult, mainly because of language differences. Our Technical Library subscribes to approximately 300 foreign technical journals—English, German, French, Spanish, Italian and Russian. The library regularly circulates a list of selected titles among interested parties. Extracts or complete translations can be secured in a reasonable time upon request.

"Dow also has foreign sales offices throughout the free world: staffed, in most instances, with technically trained personnel; and when there is a need for additional information or a more thorough investigation of technical developments in a specific field of interest we can always call on our people abroad for assistance."

VIEW

"Since we cover . . .

such a broad spectrum in our research activities, our main problem is not so much filtering, but assuring a complete awareness of available material.

"Besides the typical American abstracting services, such as Chemical Abstracts, and the Journal of Applied Mathematics listings, a relatively new service, but one which is becoming extremely important, is the Russian abstracting journal, *Referativnyi Zhurnal*. This is published in Russian, but more and more scientists are acquiring at least enough facility to make out important headings and figures; it is a good deal longer than typical American abstracts.

"We also subscribe to a large number of foreign publications and much of our information comes directly from them. We have a semimonthly internal publication which lists tables of contents and tabulated titles of articles in English from most of the foreign language publications which we receive. When an individual sees an article which he thinks would be of interest, he can request a spot translation to corroborate his judgment, and then get a complete translation. The library staff has three full-time translators, and other members of the staff are multilingual, so about 20 foreign languages can be translated internally. In addition, there are about 40 Russian journals now available in full translation. We subscribe to all those of interest to us, although they are usually delayed because of the translation problem. One often-overlooked source of information which should not be overlooked is personal contact, through correspondence and visiting delegations of foreign scientists. This avenue avoids the long delays inherent in writing up reports, as well as the translation delay."

R A KENNEDY
Library Systems Supervisor
Bell Telephone Labs

RICHARD Y MINER
Technical Staff Assistant to Chief Engineer
American Bosch Arma Corp

"Periodicals and books . . .

may be ordered direct from foreign publishers—your librarian (company or public) can advise. The New York Public Library, the Library of Congress, Harvard University and Columbia University are also major subscribers and technical and scientific societies will publish abstracts in their journals; some offer translations. Private enterprises offer abstract and translation services. These were described in PRODUCT ENGINEERING (Dec. 23 '57, p. 85, and Feb. 10 '58, p. 29).

"The US Government services physical sciences through the Office of Technical Services, Department of Commerce, and through the AEC—military customers can give special help. Direct foreign material, including periodicals, is obtainable through bookstores. A specialist in this is Stechert-Hafner Inc, 31 E 10th St, New York 3.

"We must individually fight in ourselves two fatal diseases—smugness and vanity, the killers of past great nations. We have built a nation to be proud of, but we ignore scientific papers translated into English and sent us by the Russians. Is this the way Abraham Lincoln got his education? Is this competition?"

Impact resistance—The image of impact can take many forms. To a train-conscious youngster, impact might be the crash-coupling of freight cars. To the contour miner, impact is a mammoth dipper smashing into frozen highwall. To the ordnance man, impact is a shell striking armor plate. Whatever the image, impact implies one thing—toughness.

Toughness is the ability to absorb energy—to "give" under a shock load without fracturing. This property—toughness—in steel, more than in any other material, has been vital to the building of the modern world. Steel's ubiquitous role, however, belies the complexity of toughness. Because just as there are many kinds of steel, so there are many degrees of toughness, and a given steel's toughness is shaped by the admixture of its composition, manufacture and fabrication.

The design engineer, if he is to do his job well, must know his toughness in order to select the right steel for the job. He must know something of how toughness is achieved, because this often can result in using less expensive steels. The geometry of a part or structure is also important to its toughness, and here the designer reigns supreme.

In steelmaking, toughness and strength are determined by composition and manufacturing steps. Often, as is the case with USS* "T-1" Constructional Alloy Steel, a very high level of strength and toughness is obtained through selection of alloying elements and by proper heat treatment. The steelmaker can help you obtain the best combination of strength and toughness along with other desirable properties like weldability, corrosion resistance, formability and wear resistance. He can also recommend post-fabrication heat-treating practice where it is required to develop mechanical properties or relieve stress in fabricated assemblies.

Clearly, toughness is complex. But for any application, there is one best steel no matter what combination of properties you need. You are almost certain to find that steel among the great family of USS Design Steels: Carbon, High Strength, Alloy and Stainless. Our experience is yours for the asking. Write United States Steel, 525 William Penn Place, Pittsburgh 30, Pa. You'll find our nearest representative in the Yellow Pages listed under United States Steel.

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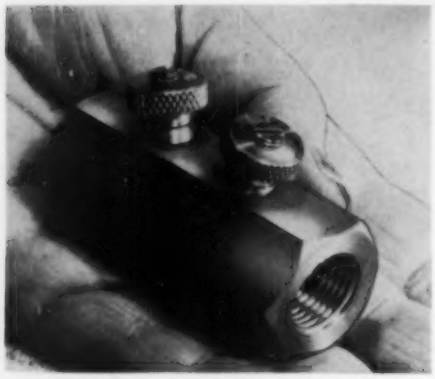
STEELS FOR DESIGN

Lower Left—Problem: Design dump cars for tunnel excavations to remove rock. Must have high impact resistance, plus corrosion resistance to withstand alternate wetting and drying. Solution: Build cars from USS Cor-Ten* High Strength Steel. Pay-off: Cars take minimum maintenance, have been in continual service for six years, and are still in excellent condition.

Lower Middle—Problem: Design a 60 cu. yd. shovel that could take the terrific abuse of all-weather overburden removal. Solution: Bucket, bail, dipper stick and crowd rack built entirely of welded USS "T-1"* Steel, a constructional alloy steel having exceptional toughness at below zero temperature and which can be field-welded and flame-cut. Pay-off: Outstanding performance in 7-day-a-week, 24-hour-a-day service with minimum maintenance.

Lower Right— Problem: Design a tank to hold the liquid equivalent of 10 million cubic feet of oxygen at 300°F. below zero. Solution: Tank was designed with impact-resistant austenitic USS Stainless Steel. Pay-off: Tank can withstand sudden changes of pressure, temperature changes and volume at low temperatures that would shatter other materials.

SIGNIFICANT COMPONENTS MATERIALS PROCESSES



2-way control valve . . .

allows independently controlled flow in either or both directions. Available in standard IPS from ⅛ to ¾ in. Adaptable to hydraulic or pneumatic applications in pressures to 5000 psi. Valves are female-threaded to dryseal specifications and are offered in brass, steel, aluminum, stainless and special alloys. No internal gaskets, springs or hinged parts. Units may be adjusted before, during or after installation with screwdriver. Straight- through ball valve principle permits sensitive adjustments and lessens clogging. Parts are said to be precision-machined to close tolerances, hand-assembled and individually tested. Standard brass valves, available from stock, range in price from $3.25 to $12 each. Others are priced higher, i.e. stainless steel, costs $15 to $43; delivery, 2 to 3 wk. **True-Flo Valve Co Inc, 79 Bow St, Everett 49, Mass.**

Circle 11, Reader Service Card

Vinyl-coated steel . . .

suitable for both flat and deep drawn parts is said to withstand elongation of 30% min without damage. Liquid vinyl plastisols are cured and bonded to sheet steel in a continuous coating process. Available in many textures, it can be embossed with any texture that can be engraved on a printing roll and produced in any specified color. Applied in coatings from 0.008 to 0.020 in. thick. Steel sheets are available in 18 through 28 gage in widths of 24 to 52 in. and lengths from 30 to 144 in. Also supplied in coils. Can be welded or otherwise fastened in most ways used for fastening steel. Withstands 160 F continuously; 212 F for 2 days. Typical price for 0.010-in. vinyl on 18-gage drawing quality sheet in quantities of 20,000 sq ft of a single color would be 35¢ per sq ft or about 2½ times price of steel alone. **United States Steel Corp, 525 William Penn Pl, Pittsburgh 30.**

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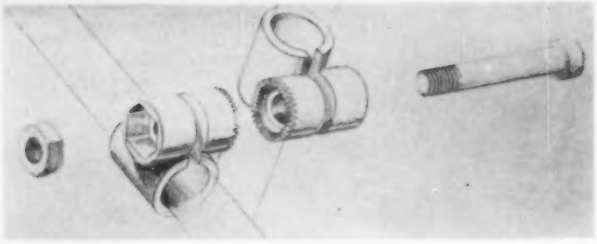

Clamp-fastener . . .

assembly is for mounting, supporting, holding, clamping. Structural system consists basically of a mounting angle with tapped holes on two sides and mounting holes and a clamp. Latter is available for ¼-in. rod or tubing, ¼-in. or ⅛-in. pipe, and for ⅜-in. BX, fitted with a rubber grommet to insulate and protect wires at cable exit. Units are equipped with locking teeth which are engaged in a vise-like grip when the screw is tightened. Any unit will match with any other, or with a like unit, to give perpendicular or parallel relationships, or angular positioning in 10° increments. In standard packages, 10 assemblies average about 84¢ each; 5000 assemblies average about 35¢ each. **Versa-Loc Corp, Southern Blvd, Chatham, NJ.**

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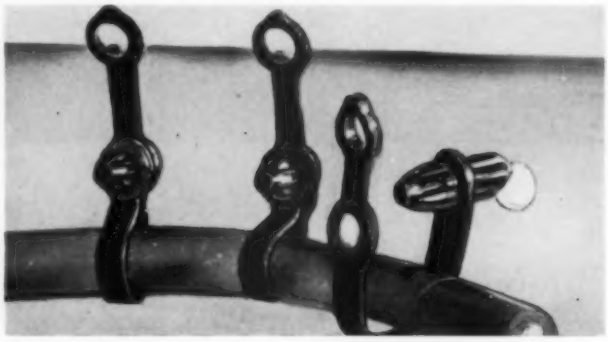

Push-to-fasten . . .

device eliminates need for threads, nuts, lockwashers and other fastening hardware, and provides uniform holding power. Parts are pushed into place through a punched or drilled hole and a series of molded flutes, extending radially from a plastic stud, deflect exerting outward pressure uniformly around entire circumference of hole. Parts align and are said to resist loosening in either wood or metal. Adaptations of the design have been used in cable supports and electrical terminals. **Whitso Inc, Dept PEN, 9330 Byron St, Schiller Park, Ill.**

Circle 14, Reader Service Card

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for short periods and can be used continuously at 500 F. Clear epoxide, 2-component coating may be applied by dip, brush or spray. Recommended thickness for single coat is 7 mils max; multiple coats build up thickness. Suitable for coating printed circuit boards, electronic circuits and components, metal and ceramics; and can be used in place of varnish for dipping or impregnation of coils or motor windings. **Emerson & Cuming Inc, 869 Washington St, Canton, Mass.**

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Carlstadt, N. J.

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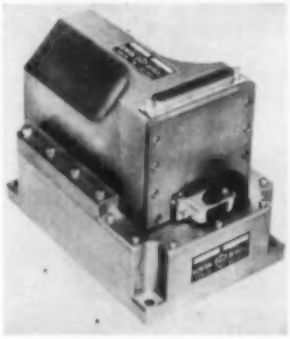

Commutator-gating units . . .
in all standard IRIG sampling rates and channel configurations accommodate high level inputs from 0 to 5 v full scale, as produced by standard signal sources. Potentiometers, cathode followers and voltage references are among typical signal sources. Unit consists of electromechanical commutator and gating circuit. Single subminiature vacuum tube achieves specified high-input impedance. All other active circuits elements are silicon. Can be disassembled from electronic gate assembly by removing eight screws and a connector. **General Devices Inc, PO Box 253, Princeton, NJ.**

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are rated 257 cfm at 100 psi. Poppet pilot single and double solenoid-operated control valves are available in standard ac and dc voltages. Housings are aluminum castings. Flow is through hollow, radially ported, stainless steel plunger and out connected piping. Pilot employs fluid pressure to operate valve, instead of applying solenoid force directly against valve plunger. Furnished in two, three or four-way action; two position and three position designs. Equipped with subplates either side- or bottom-tapped for ⅜ or ½-in. pipe connection. **Hunt Valve Co, Salem, Ohio.**

Circle 18, Reader Service Card

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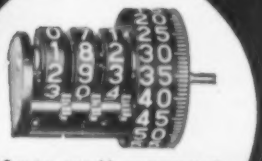
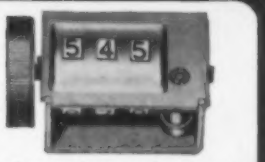


Counter assembly component of navigating instrument to indicate increments of measurement for fast, legible, direct "read-out".



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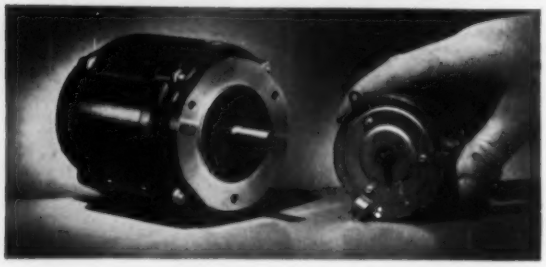

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Electromechanical decoder . . . can be set to respond to any of 20 million combinations of coded digital pulses. Actuated by telephone dial or electromechanical or electronic encoder. Decoder is energized by dc pulses . Response code is set by placing code pins into small holes near periphery of 70-tooth code wheel. Intended for remote signaling or control. **Secode Corp, 555 Minnesota St, San Francisco 7.**

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Camera prints digital data . . . on 35mm motion picture film. Provides 96-bit matrix image on each frame, correlating coded data with pictorial records in real time. May be used to record time, temperature, pressure, vibration, stress, shaft position, and similar coded digital data. Cameras can be operated at any frame rate to 80 frames per sec. At max speed, the camera can record 7680 bits of coded information per sec. Available on Traid 75 Fototracker and Bell & Howell Model 71 Eyemo cameras. **Traid Corp, 17136 Ventura Blvd, Encino, Calif.**

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NEW LITERATURE

Better Writing–but How?

TECHNICAL EDITING. *Edited by B H WEIL. 5 x 7½, 278 pp, $5.75.* **INFORMATION AND COMMUNICATION PRACTICE IN INDUSTRY.** *Edited by T E R Singer. 6 x 9, 304 pp, $8.75. Both books published by Reinhold Publishing Co, 430 Park Ave, NY 22.*

Sermons on the need for better writing now total an enormous number of words. Particularly in the technical world we hear anguished cries about the confused and cryptic writing that wastes the reading time of busy engineers. Unfortunately, most of this is lip service—the situation is given a thorough scolding but the how-to-solve-it remains a puzzling question that attracts only a few lonely pioneers. What is the answer? Or is there more than one answer?

Usually, how-to books on the subject take the approach that there is more than one. We are in an age of specialization, so let advice to the would-be communicator be specialized. The editor of *Technical Editing*—to which 20 guest editors contributed specialized chapters—believes his is the first book specializing on technical editing. The editor of *Information and Communication Practice in Industry* has gathered together 18 specialized guest chapters aimed at servicing industrial information departments. And a recent book by the same publisher (PE—Feb. 24 '58, p 46) added to the specialized books on "better report writing."

To some extent, of course, these books echo each other. And the guest-editor method innocently violates a precept of good editing by filling one chapter with the same "thou shalts" repeated by a neighboring chapter in the same book.

Also distinguishing today's technical-writing books is the amount of rehashing they do of each other. Not that credit isn't given. Quite the contrary. Now that technical writers and editors have acquired such modern-sounding, impressive titles as "communications engineer," they are naturally eager to demonstrate that theirs is an authentic branch of technology. One demonstration is to show that they have diligently searched the literature. And so they fill their books with bibliographies. One of Mr. Singer's chapters, for example, cites 139 references and the "Editing Know-how" chapter in the Weil book cites 116.

But is it old stuff, in a new bottle, that the reader wants? What he needs is a fresh book that smells as much of fresh "how-to" for modern technology's writing problems as it does of fresh printer's ink. Ideally it should be written by a single person who is doubly qualified—who knows the precepts of good writing, and is at home in today's science era. Also, his tutoring should be done with shirtsleeves rolled up; in other words, a craftsman's book rather than one written from the pedant's viewpoint. Such books—practical and not limited to one specialty—occasionally appear for the nontechnical writer. The field of technical writing deserves one too.—WG

CAPABILITIES—Brochure, 92 pp. Pictorially describes scope of available engineering services in chronological order, ranging from conception of an idea to progress and results. Excludes specific reference to products, facilities, personnel. Cook Electric Co, 2700 N Southport Ave, Chicago 14.

Circle 1, Reader Service Card

AUTOMATING ENGINEERING DRAWING—Illustrated paper, 16 pp. Covers the whys and wherefores of the Westinghouse decision to automate engineering drawing reproduction. An analysis of methods used and how they can be applied to small and large firms. Authored by T H New, manager of Office Systems and Services of Pittsburgh Div, Westinghouse Electric Corp. Filmsort Co, Pearl River, NY.

Circle 2, Reader Service Card

MOTOR CONTROLS—Catalog 14, 78 pp. Presents size, weight and ratings for motor controls and accessories. Index lists catalog numbers and type. Arrow-Hart & Hegeman Electric Co, 103 Hawthorn St Hartford 6, Conn.

Circle 3, Reader Service Card

ENVIRONMENTAL TEST FACILITIES—Bulletin, 6 pp. Explains and illustrates electronic and electromechanical environmental test facilities, operating independently. Describes testing laboratory for individual instruments and components or complete systems. BJ Electronics, Borg-Warner Corp, 3300 Newport Blvd, Santa Ana, Calif.

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Publisher's Postscript...

Times Have Changed

Only a few years ago, if an engineering publication reported a Russian technological advance, editor and publication were immediately suspect. If not a card-carrying member, the editor was at best a fellow traveler.

Some of our readers will remember such a report published in Product Engineering in February 1953. It described Soviet engineering education and how the Russians were graduating far more engineers each year than we were. The editors concluded that Soviet training, ". . . may come as a surprise to many American engineers who have felt that Russian engineers were little better than blacksmiths."

The story got wide newspaper publicity at the time. We were praised for our courage and foresight by many, but we also got a whale of a lot of criticism, ". . . playing into the hands of a potential enemy . . ."

"But that was six years ago," you'll say. "We're a wiser, if sadder profession today. Less complacent about our own technology, we're more willing—even eager—to listen and read and learn about what others are doing."

Is that so? One of our readers dropped into the office the other day and, pointing to the many Soviet developments we've reported, he wondered if we weren't unduly influenced by Soviet propaganda. Perhaps we're making mountains out of molehills, he thought. But it didn't take him long to change his mind. After a brief talk with Editor Elmer Tangerman (who saw Soviet engineering first-hand last year) our visitor learned of Russian developments *in his own field* (plastics—see *PE—Feb 9, p 23*) that made him sit up and really take notice.

We can no longer operate in a vacuum. If we close our eyes to reports of foreign developments, it's our loss. They don't make the same mistake.

Look over the names of our editorial staff on page 4 of this issue. You'll find that we have editors in most foreign industrial centers. These men are not just stray "correspondents." They are chiefly full-time McGraw-Hill salaried editors who report daily to headquarters in New York. They have their eyes and ears tuned to the industry, the laboratories and the universities of the world. They screen fact from fancy and then teletype or cable their reports to our home office where engineering editors evaluate, interpret, and often request more detailed information by return teletype or cable.

What we publish is at the narrow end of a tremendous funnel. It can't be found elsewhere. Ignore it at your own risk. —AH

For Your Information (personal)

Telling 'em from way off

First remote-station dictating system to use magnetic tape for recording is claimed by Scribe Internationale, Div of General Sintering Corp, Oak Park, Ill. The system, which "allows all dictating functions to be controlled directly by the dictator," regardless of the location of the recorder-transcriber, can handle up to three dictating stations, connected either by direct wire or through an existing switchboard. The dictator's desk unit, pictured here, is 5 by 8 in. Microphone has thumb-control bar for starting and stopping the recording unit, play-back, and error-correction.

Putting the finger on fallout

If fallout from atomic bombs has your family worried, Tracerlab Inc has good news. Company engineers say they have developed an inexpensive detector and warning device that can be plugged into any radio or TV set. It will not only sound an alarm but also indicate the direction in which safety lies.

The device (Tracerlab dubs it the "Banshee") combines a radiation detector with an electrical system that will sound a wailing alarm through the radio or TV loudspeaker. The alarm increases in pitch as the amount of radioactivity increases. The latter feature is expected to aid escape from the radioactive area—by traveling in the opposite direction, one should be able to find a haven.

Tracerlab says the basic components are inexpensive and believes the device could be produced in quantity for about $5.

Autos: lower and lower?

Automotive road clearances are at rock bottom right now, says the American Petroleum Institute's automotive parts and design subcommittee. In most current models only a few parts like the frame-and muffler are crowding the limit. But, the committee predicts, "as space becomes more limiting in future designs, the tendency will be for everything that is underneath the car to come down to the minimum level."

Service-station men have long complained about this downtrend, without too much effect. But now, the API notes, car makers are beginning to recognize the problems it creates in maneuvering sharply angled driveways and loading haul-away trucks, and committee members are hopeful no further lowering will occur.

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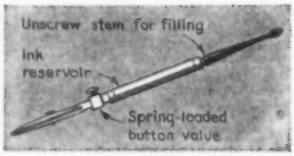
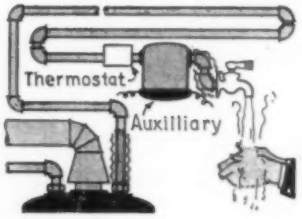
Why Don't They

R ESEARCH and D EVELOP . . .

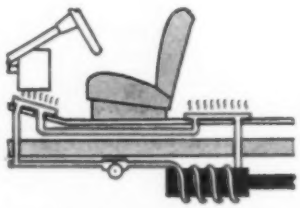


. . . a ruling pen with built-in ink reservoir. This would eliminate constant refilling by draftsmen and permit drawing long heavy lines without interruption. The small button-controlled valve could cut off flow when released so that ink would not dry out. —S. DUDNIK

. . . a method to eliminate the static charge created when grinding plastic materials? The charge causes grinding dust to cling to the work, making a serious and expensive cleaning problem for molded plastic parts. —N A SAVAGE



. . . a light-duty thermostatically controlled resistance-heating element (possibly combined with an auxiliary tank) to be attached to hot water piping systems between heater and faucet. While uneconomical as the main heat source, this supplementary heater would operate only when the pipe water dropped below the set temperature. The pipe should probably be insulated making hot water delivery in tall buildings and industrial plants constant and practically instantaneous. —W ROSENBERG



. . . radiant heaters for automobiles? Expanded-tube panels could be used in the floors, side panels, firewall or seat scuff boards to warm the feet quickly and without overheating the car air. Hot water could be taken from the radiator circuit, but what about adding a hot water heat exchanger to the exhaust pipe system? The muffler would be kept cooler, exhaust pressures would be lower and the car would be warmed up more quickly. —J J KELLEHER

Have you a pet subject but neither the time nor inclination to do the necessary R & D? Product Engineering will welcome (and pay $10 each for) similar ideas based on known scientific principles but lacking an inspired manufacturer

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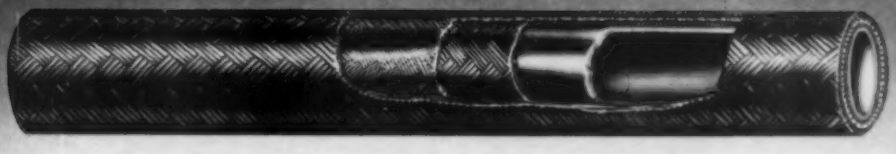
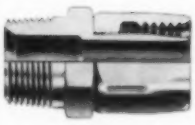
Cut Costs! Use Aeroquip 2601 Lightweight Hose and Fittings for Engine Oil and Fuel Lines



Type 2601 HOSE construction: synthetic rubber inner tube, cotton inner braid, single wire braid reinforcement, impregnated cotton braid cover. Working pressures: 125 psi. to 1000 psi., depending on size. Temperature range —40°F. to +300°F. Sizes ¼" to 2".



Male Pipe—¼" to 2"

S.A.E. Swivel—¼" to ¾"
J.I.C. Swivel—¼" to 2"
P.T.T. Swivel—1" and 1¼"

Split Flange Fittings in straight, 45° and 90° elbows

Swivel Nut Fittings in straight, 45° and 90° elbows plus special configurations

New Aeroquip 2601 Lightweight Hose is a high quality product that offers important advantages to engine and equipment designers:

Special construction features permit savings to the OEM customer of 4¢ to 13¢ per hose/foot over conventional heavy-duty hose lines.

It has a wide operating temperature range to meet the requirements of all engine systems (—40°F. to +300°F.).

It can be used, on Aeroquip approval, for fluid transfer applications such as air, water, mineral oil and hydraulic return lines in addition to engine fuel and high temperature oil lines.

It has good flexing characteristics and outstanding resistance to engine vibration.

It is available in 10 sizes, from ¼" to 2" O.D. tube, with a full range of reusable fittings: S.A.E., J.I.C. and P.T.T. swivel; male pipe; and standard 4-bolt and split flange ends. Standard 45° and 90° elbow fittings plus special elbow configurations are also available.

Full design information is available on Aeroquip 2601 Hose and Reusable Fittings. Fill in and mail the coupon below for a copy of Engineering Bulletin IEB-34. If you have a special fluid line problem, outline your requirements to our sales engineering staff. Write today!

Aeroquip 2601 Hose Lines are now used for diesel fuel and lube oil lines on Clark Equipment Company's Michigan Tractor Dozers.

Aeroquip Corporation,
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Please send IEB-34 on new Aeroquip 2601 Hose and Reusable Fittings.

PS-2

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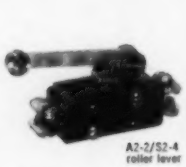
single pole

actual size

S series
SPDT



L.W.H. 1¼" x ½" x ½"
Elec. Rating: 10 amps @ 125/250 V.A.C.
10 amps @ 30 V.D.C.
Operating Force 9 to 15 oz.
Amb. Temp. −100° to +375° F.
Termination: S1—end solder,
S2—screw
S3—side solder
S5—U-bent
S6—long screw
For switches conforming to Military and U.L. approval, write for details.
Reset types also available.

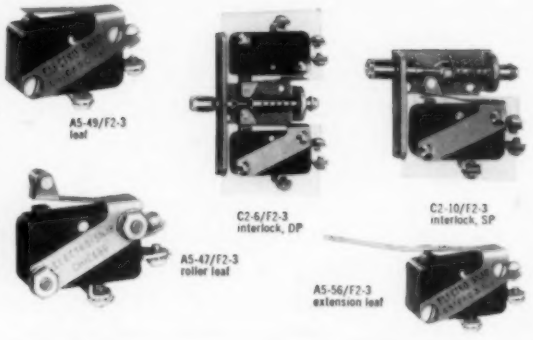
In stock? WE HAVE THEM...

single pole

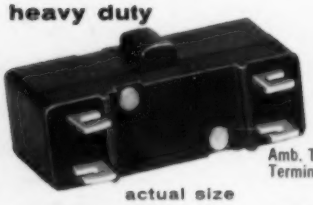
actual size

F series
SPDT

L.W.H. 1-3/32" x 13/32" x ⅜"
Elec. Rating: 10 amps @ 125/250 V.A.C.
60 cycles
10 amps Res. @ 28 V.D.C.
6 amps Ind. @ 28 V.D.C.
Operating Force 7 to 12 oz.
Amb. Temp. −100° to +350° F.
Termination: F1-solder, F2-screw
May be banked with unlimited units per row. For switches conforming to Military and U.L. approval, write for details.



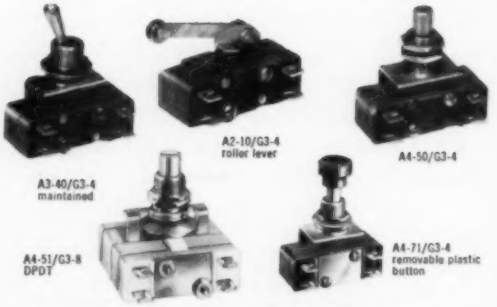
heavy duty



actual size

G series
SPDT, 2 CKT.

L.W.H. 1¾" x 43/64" x 35/64"
Elec. Rating: 40 amps @ 125/250 V.A.C.
40 amps Res. @ 30 V.D.C.
30 amps Ind. @ 30 V.D.C.
Operating Force 45 oz.
Amb. Temp. −100° to +300° F.
Termination: G3—side solder
G4—top and bottom screws
Reset models also available. For switches requiring Military and U.L. approval, write for details.



40 amps? YES...

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